tech engineering news

november 1950

What Happens When 150,000,000 People Say:

"I WANT!"

THE STORY OF OIL

COLONEL Edwin Drake's oil well, drilled in 1859, produced only 20 barrels daily . . .

But it gave people a taste of the benefits of petroleum—and a great industry was off to a flying start!

The first drilling rigs—first refining equipment—were adequate for that early demand.

But invention of the automobile, airplane, Diesel engine and other great machines in turn demanded great invention in oil—and old-fashioned equipment gave way to scientific research laboratories, modern refineries, pipelines, tankers and tank cars.

Each year demand made them bigger and better!

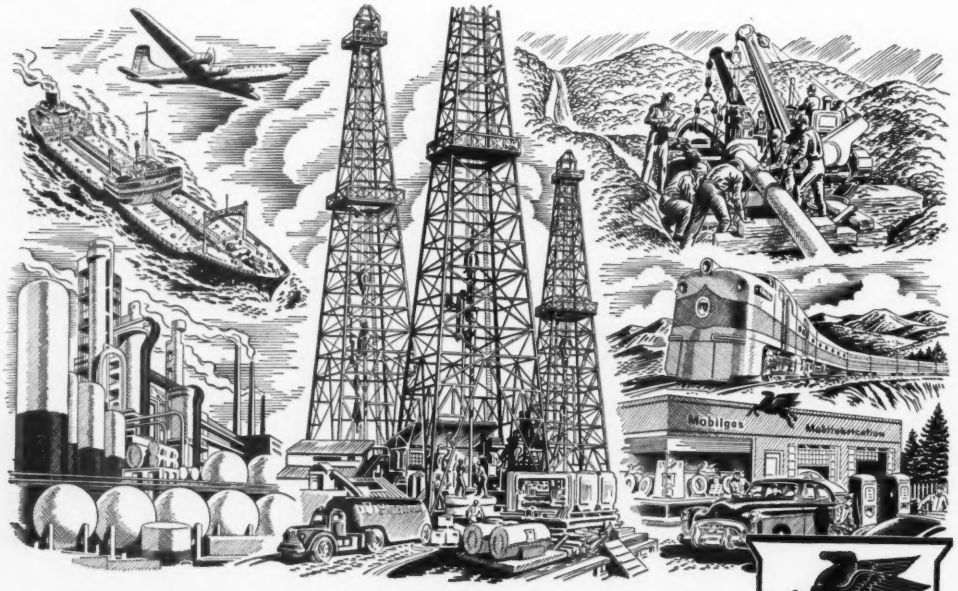
Today, thousands of oil companies with oil fields, refineries, bulk plants, service stations and cost-cutting transportation systems—deliver over 1,840,000,000 barrels of petroleum yearly—meet U.S.A.'s demands for *value in oil.*

And, today, the responsibilities of Socony-Vacuum, one of the oldest companies in the industry, are constantly mounting . . .

Unprecedented demand for petroleum products calls for expansion in every phase of our efficient, coordinated operation . . .

46,400 independent "small" businessmen must be kept *competitive*—supplied with what it takes to provide a *big money's worth* for you—a good living for themselves.

When 150,000,000 Americans say, *"I want,"* it takes businesses of all sizes to deliver!



DEMAND DETERMINES BIGNESS

The Flying Red Horse Companies

SOCONY-VACUUM OIL COMPANY, INC. • MAGNOLIA PETROLEUM CO. • GENERAL PETROLEUM CORP.

SOCONY-VACUUM

out of the briny deep!

Metal furniture, lawn mowers, and materials for aircraft out of the briny deep? Drugs, ink, paper products, fumigants and photographic plates from ocean water?

Indeed, these products and many more owe their origin to elements extracted from the brine of the sea and from the earth's subterranean brines . . . bromine, iodine and magnesium.

The first of these, bromine, appears in a host of products which we use daily. For years this basic chemical has been produced for industry by The Dow Chemical Company. Bromine and bromine compounds are utilized in many fields including textiles, petroleum, solvents, fumigation, cosmetics, pharmaceuticals and a variety of others.

In addition to its medicinal use, iodine has many industrial applications, among them dyes and photographic film.

Magnesium, the lightest of all structural metals, is likewise extracted from the inexhaustible waters of the sea through a special process originated by Dow. Proved invaluable for over a decade in aircraft construction, magnesium today contributes strength without dead weight to many varied industrial and consumer applications.

Bromine, iodine, and magnesium are but three of over six hundred products manufactured by Dow in the interests of "chemicals indispensable to industry and agriculture."

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Atlanta • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle
Dow Chemical of Canada, Limited, Toronto, Canada

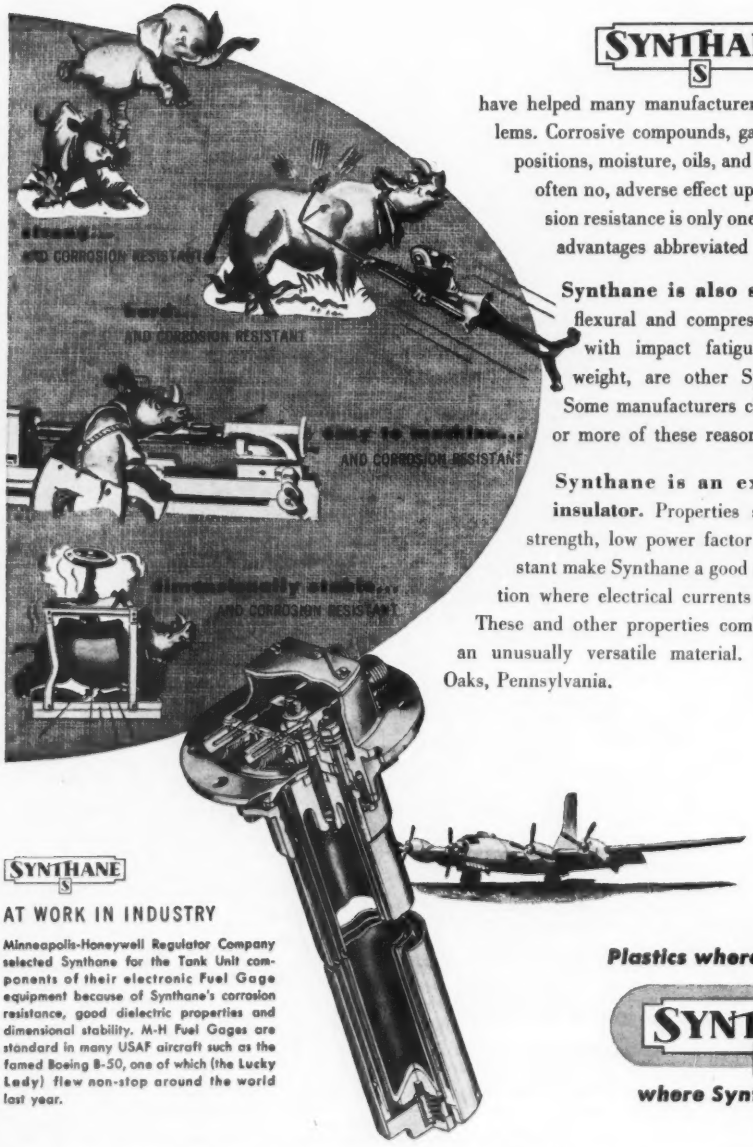
DOW

CHEMICALS

INDISPENSABLE TO INDUSTRY AND AGRICULTURE

Will Corrosion Resistance + "X"

Help You Solve A Problem?



SYNTHANE plastic laminates have helped many manufacturers solve corrosion problems. Corrosive compounds, gases, various water compositions, moisture, oils, and gasoline, have little, and often no, adverse effect upon Synthane. But corrosion resistance is only one of many other Synthane advantages abbreviated to the "X" above.

Synthane is also strong. Good tensile, flexural and compressive strengths, together with impact fatigue resistance and light weight, are other Synthane characteristics. Some manufacturers choose Synthane for one or more of these reasons.

Synthane is an excellent electrical insulator. Properties such as high dielectric strength, low power factor and low dielectric constant make Synthane a good material for any application where electrical currents must be held in check. These and other properties combine to make Synthane an unusually versatile material. Synthane Corporation, Oaks, Pennsylvania.

SYNTHANE

AT WORK IN INDUSTRY

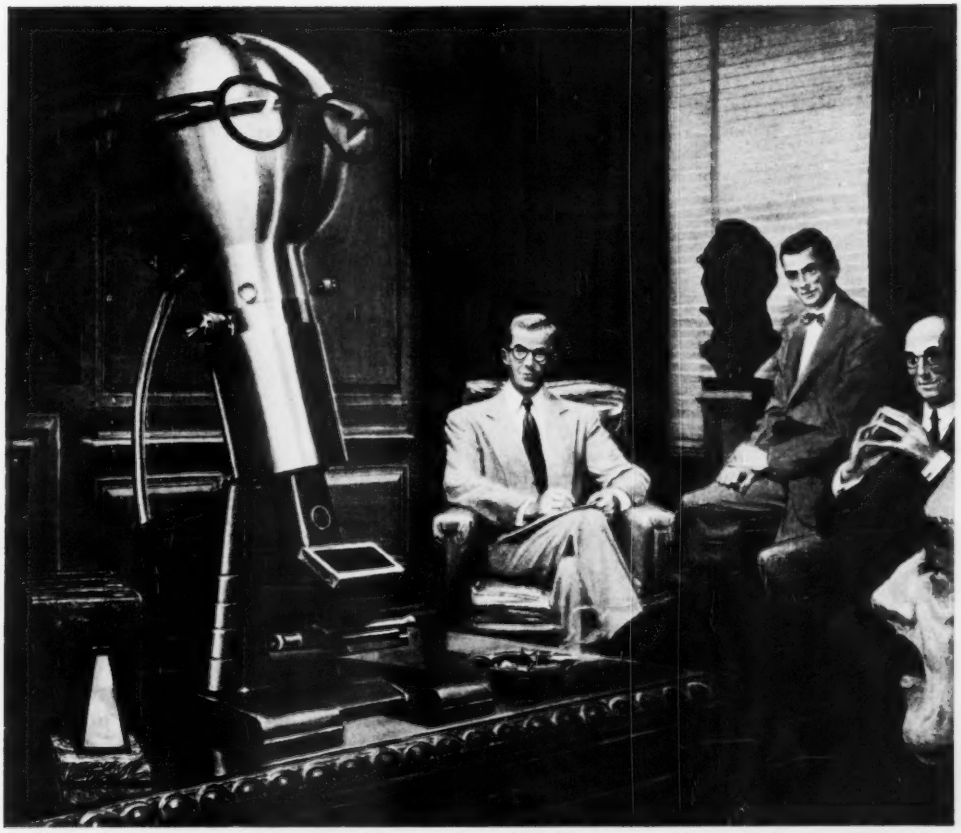
Minneapolis-Honeywell Regulator Company selected Synthane for the Tank Unit components of their electronic Fuel Gage equipment because of Synthane's corrosion resistance, good dielectric properties and dimensional stability. M-H Fuel Gages are standard in many USAF aircraft such as the famed Boeing B-50, one of which (the Lucky Lady) flew non-stop around the world last year.

Plastics where plastics belong

SYNTHANE

where Synthane belongs

DESIGN • MATERIALS • FABRICATION • SHEETS • RODS • TUBES • FABRICATED PARTS • MOLDED-MACERATED • MOLDED-LAMINATED



Portable electron microscope, developed by RCA, widens research in universities, industries, hospitals.

The new instructor gets a hearty welcome

You've read, in both newspapers and magazines, about the powerful electron microscope. Now this amazing "instructor" of scientists, physicians, and engineers becomes even more useful—in more research fields.

Through principles uncovered at RCA Laboratories, RCA engineers have developed a compact "table model" electron microscope, at a price which makes it practical for use in an increased number of universities, industries, hospitals, clinics. So simplified is the new instrument that even a high school student or unskilled laboratory technician can quickly learn to use it!

Magnifications of 6000 times can be obtained directly in RCA's portable electron microscope—four times that of ordinary light microscopes—and photography lifts this to 30,000! A new "instructor," yes—and one that gets a very hearty welcome.

* * *

See the latest wonders of radio, television and electronics in action at RCA Exhibition Hall, 36 West 49th Street, New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, New York.

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Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

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- Design of component parts such as coils, loudspeakers, capacitors.
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- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RCA

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

tech engineering news

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FRONTISPIECE

Electron Microscope. Photograph of Trichocyts from Paramecium, 30,000 Diameters.

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the strange power of the mind

Knowledge Without the Five Senses

By Joel Ekstrom, '52

Through all the ages of history there are references to people who seemed to have the ability to forecast future events, to locate hidden objects, and to read other people's thoughts without the use of any of the five recognized senses. For centuries these people were ridiculed, accused of sorcery, and in many cases punished severely. However, with the adoption of the scientific method in the seventeenth century there came a more liberal attitude on the part of scientists in general. This gave some scientists the courage they needed to investigate the "forbidden" fields of thought transference, etc.

The field of Extra Sensory Perception, or ESP, is divided into four sub-fields. Telepathy is the ESP of a person's thought, while clairvoyance is the ESP of a material object. Precognition, the foretelling of coming events — especially disastrous ones, and psychokinesis, the "mind-over-matter" control of material objects — such as the causing of falling dice to come up on a certain number more times than can be accounted for by chance — will not be discussed here. These are new and very controversial fields and research in them is where research in telepathy was many years ago. Nor will cases of non-experimental or spontaneous telepathy or precognition be discussed. Although they often give warning of a relative or friend in danger, they occur under conditions which would make experimental ESP next to impossible. However, we must not lose sight of the importance of these spontaneous cases, since they provided the impetus for the experimental work that has been done to date.

The earliest known society organized specifically for the purpose of carrying out experiments in the field of ESP was the English Society for Psychical Research, which was founded in 1872 and which included as members such eminent British physicists as Sir William Crookes, Sir Oliver Lodge, and Sir J. J. Thompson. One of its earliest tasks was an investigation of the supposedly phenomenal telepathic abilities of the Creery sisters, who were said to be able to read thoughts with consistently amazing accuracy. The Society conducted controlled experiments with the sisters; the results seemed significant until someone claimed he had caught them trying to signal to each other. Although their earlier work may have been honest, the mere fact that they were later caught cheating casts doubt over all their previous "accomplishments." Of course the Society is still carrying on research, but the case of the Creery sisters is mentioned merely to point out that research on ESP has been going on for some time.

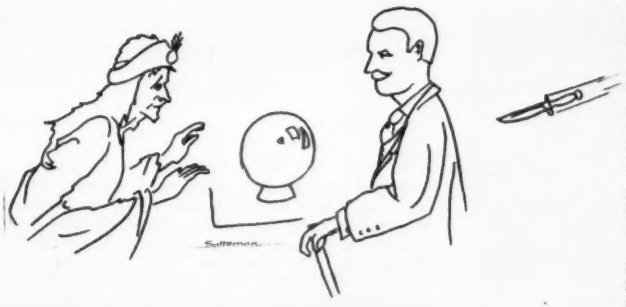
The main trouble with the early researchers was that they did not succeed in separating telepathy from clairvoyance, probably because they did not know that they were separate but related processes. After the turn of the century, however, telepathy and clairvoyance were separated for individual study and the testing techniques were greatly improved, as will be shown.

One of the earliest of the twentieth century researchers was Rene Warcollier. His clairvoyance and telepathy experiments with drawings and mental images of drawings and objects, carried out so as to exclude the possibility of sensory perception, were performed "successfully" over distances up to three thousand miles. The experiments were tried by many people — including Dr. Nicholas Murray Butler of Columbia University — and quite a few "significant" results were obtained. By significant we mean that either the percipient's reproduction of the original drawing was near-perfect or else it contained more resemblances to the original than could seemingly be accounted for by chance. After evaluating the results of his experiments, Warcollier concluded that ideas of motion and color could be transmitted by ESP; and that the significance of the image received meant nothing, since people blind from birth and small children could successfully "receive" and express in drawings their perceptions.

Others whose work was important enough to merit mention were Mr. and Mrs. Sinclair Lewis, who conducted experiments similar to those of Warcollier under the most rigid control system they could devise and reported their results in a book entitled "Mental Radio"; Dr. Estabrooks of Harvard, who used in his experiments a great number of percipients each of whom was well separated from his agent; and Professor J. E. Coover of Stanford University, whose 600 page report on ESP experiments was for many years the "bible" of the researchers.

In concluding this brief discussion of the beginnings of organized research, it is worth mentioning that although the greatest amount of research was done by groups organized specifically for the purpose, much private research was being done by interested persons in all walks of life. College labs for research on ESP were rapidly springing up, and it was at the Duke University lab that the work given the most attention in this article was started by Dr. Karl Zener and continued by Dr. J. B. Rhine.

The importance of the Duke experiments lies not only in the elaborate precautions taken to exclude



sensory perceptions but also in the very large amount of data that has been collected by Dr. Rhine and his associates. Large amounts of data are very necessary in experiments of this type because small deviations from chance scoring levels mean little unless the number of trials is very great. Most of the tests at Duke have been conducted using a set of cards designed by Dr. Zener. The set consists of twenty-five cards — five with circles, five with stars, five with squares, five with wavy lines, and five with plus signs. In the telepathy tests the agent concentrates on a mental image of a particular card and the percipient tries to determine what symbol the agent is thinking of. In the clairvoyance tests the agent concentrates on the back of the cards — one at a time — and the percipient tries to determine the order of the cards. Naturally, no agent is theoretically necessary in clairvoyance tests since objects rather than thoughts are being "read." However, much more research on the role, if any, of the agent in clairvoyance tests needs to be done. In the tests employing both telepathy and clairvoyance the agent concentrates on the front of each card while the percipient tries to determine the order of the cards. In any case, chance scores on large numbers of runs would average out to five correct hits because a percipient could guess twenty-five circles or twenty-five stars, etc., on each run and still get five correct. If in the long run, scores average out considerably above the chance level of five, there is reason to suspect some extra-sensorial mode of perception, provided of course that all means of sensory perception are excluded.

Before going into the actual details of the experiments it might be well to mention that this ESP ability, if in truth it does exist, apparently exists normally in all persons to a greater or lesser degree. Dr. Rhine has gotten what seem to be significant "results" with people ranging in age from five to seventy. For obvious reasons most of his subjects have been interested college students — both men and women — from Duke and the surrounding colleges.

The first experiments at Duke were of the combined telepathy and clairvoyance type. Then these two variations of ESP were separated and each was tested for separately. The variations in testing technique described below were tried with all three types of tests; the results were about the same in all three cases, thus suggesting that the processes of telepathy and clairvoyance are probably variations of the same general process. Another observation which supports this hypothesis is that "high-scorers" in any one of the three types of tests are usually "high-scorers" in the other two.

ESP tests with the percipient under hypnosis were first tried by Dr. Lundholm, but the results were no better than those obtainable without hypnosis. Hypnosis was also tried by Dr. Rhine, but he also reports rather insignificant results in experiments to date. These tests take much longer and not everyone can be or is willing to be hypnotized; therefore the collection of enough data for statistical analysis is very difficult. There is certainly room for much more research in this field.

Drugs such as caffeine, alcohol, and sodium amytal have a very pronounced effect on scoring. Sodium amytal, a dissociation drug, decreases scoring ability remarkably — often to below-chance levels — while caffeine, an integrating drug, will counter the effect of sodium amytal and will sometimes increase the scoring ability over the no-drug level. Alcohol in moderate doses slows down the responses but seems to increase the vivacity of the received images. These particular experiments seem to indicate that if ESP exists at all it is closely tied in with the normal processes of the nervous system. This relation is further brought out by the observations that fatigue, a formal and inflexible routine, and the lack of concentration, enthusiasm, and confidence rarely if ever allow good results to be obtained by the percipient.

Perhaps the most fascinating experiments performed at Duke have been those done to see if great distances and various barriers between the agent and the percipient or between the object and the percipient make any difference in scoring. Distances of separation up to three thousand miles or more have been tried and in no case has there been any significant suggestion of an inverse or other relationship between scoring level and distance of separation. Barriers of all sorts have been tried; again no significant changes in scores have been noticed. ESP would certainly seem to defy all known principles of energy transmission.

An observation which has often been made is that a person's ability to score above chance decreases slowly as the tests go on. This has been attributed to either or both of the following causes: the percipient has lost

(*Continued on page 22*)

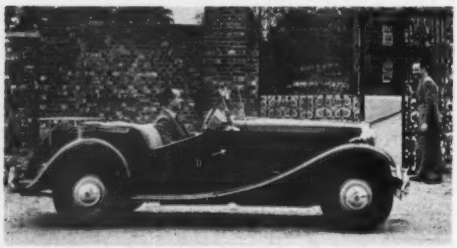
foreign automobiles

They Are Small, Speedy, and Expensive

By Tony Ranti, '53

Ranging between the sleek Jaguar XK 120 on the right and the sporty M.G. below, motorcar design has been subtlety revised abroad. The Italian automotive industry was quick to imitate the postwar American design. The Fiat 1400, which was built especially for export purposes, has a one-piece, curved windshield and a profile which resembles a 1949 Kaiser. The Maserati, Isotta-Fraschini, and the Cisitalia have also acquired the American look. The British have remained static, developed a style of their own, and are producing a few automobiles which have the American look.

Unless the names of Daimler, Bentley, Lagonda, Jaguar, and Rolls-Royce have a permanent strangle hold upon your imagination, you will have to confess, I think, that these cars, which bear these ancient and honorable names, are not much to look at. They are big, they are bright, and they *do* look expensive, but the distinction of their characteristic verticality has nearly disappeared. In the Rolls-Royce, with its traditional monumental bulk, you will see the last of its radiator design — the square front with the truncated triangular top and upright against the wind.



Nickel Topics

Brisk lines, small-scale comfort, and athletic performance are characteristic of the M.G. Midget.

However, there still are many people throughout the world who consider the characteristic English style to be correct for a quality car.

There is a cliché of British design — each of the front fenders handled as a single tear drop — which I find just as unattractive as the fads which periodically run their course through American cars; and this year over twenty of the British makers are using it. One notable automobile in the British line is the Hillman Minx convertible, which manages with extraordinary grace to improve on the American formula which it imitates. The few British automobiles which do have the American look are small and should be well suited for economical city driving.

Most foreign automobiles are small, economy models adapted to the European economic pinch. They are the practical products, but there are many pedigree chassis covered with custom coachwork and prohibitively priced. They are built for purposes other than direct sales. Built for what? Prestige is the answer.

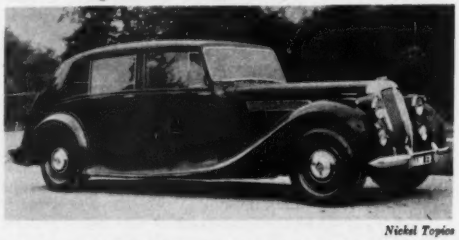
The foreign automobile manufacturers are keenly interested in prestige. In Europe, contrary to the American policy, a large number of automobiles are custom built, with the coachwork tailored to the taste of each individual purchaser. Rolls-Royce, which has adopted the modest slogan, "The Best Car in the World," is delivered in New York City for $14,000 and

Nickel Topics

The sleek two-seater Jaguar XK 120 is powered by a 160 horsepower engine.

up. The custom-built bodies which accompany the chassis draw world-wide attention. How can one but notice a body which is covered with basket weave and copper-plated grille and fenders? Built-in quality and longevity have been achieved by a company whose chief engineer still drives his 1923 model, which has covered 375,000 miles without so much as a single reboring of the engine.

Prestige, in connection with the automotive life of Europe, is an ambiguous word with various possible connotations. In Europe there is an ardent love of the automobile which is quite unlike anything generally encountered in the United States. The American motor industry is admired around the world for its productive efficiency. Its products are internationally sought after for their comfort, their sound and dependable performance, and their reasonable price. For these the United States auto industry is indubitably ahead of the foreign automotive industry.



Nickel Topics

For nearly half a century the firm of Daimler has made automobiles for the King of England and members of the Royal Family.

statistics of foreign and american automobiles

Make	Country	Wheel Base (in.)	Weight (lbs.)	H. P.	Price*	Mileage (mpg)
Allard	Br.	112	2,688	85		14
Allard J2	Br.	100	1,904	140		12
Aston-Martin	Br.	99	2,464	105		20
Austin A40	Br.	92½	2,164	40		26
Austin A90	Br.	96	2,805	88	$1,480	18
Buick Special 8	U. S.	122	3,710	115	1,941	14–16
Buick Super (51)	U. S.	122	3,745	124	2,139	
With Dynaflow	U. S.	122		128	2,300	
Buick Roadmaster Dynaflow Standard	U. S.	130	4,220	152	2,738	
Bentley	Br.	120	3,935	135		15
Cadillac 61	U. S.	122	3,941	160	2,868	
Cadillac 60S Hydramatic Standard	U. S.	130	4,056	160	3,797	
Chevrolet	U. S.	115	3,120	92	1,450	
With Powerglide	U. S.	115	3,230	105	1,668	
Chrysler 8 Saratoga (Prestomatic)	U. S.	132	4,170	135	2,687	
Daimler 2½ Liter	Br.	114	3,472	85		20
Daimler St. 8	Br.	144	5,830	150		9
De Soto with Tiptoe Shift	U. S.	126	3,525	112	2,006	
Dodge	U. S.		3,020	103	2,061	
Ford 6 with Overdrive	U. S.	114	3,048	95	1,472	
Ford 8 with Overdrive	U. S.	114	3,083	100	1,545	21–24
Ford	Br.	94	1,792	30	998	28
Frazer	U. S.	124	3,535	115	2,559	
Healey Silverstone	Br.	102	2,180	108		23
Healey Sportsmobile	Br.	102	2,064	105		23
Hillman Minx	Br.	93	1,905	38		26
Hudson Pacemaker	U. S.	120	3,510	112	1,983	17–19
Hudson 8	U. S.	124	3,605	128	2,189	
Humber Hawk	Br.	103½	2,702	56		20
Jaguar XK120	Br.	102	2,464	160	3,945	16
Jowett Javelin	Br.	102	2,128	50		21
Jowett Jupiter	Br.	93	1,568	60		20
Lagonda	Br.	153½	3,248	105		14
Lincoln V-8	U. S.	121	4,001	152	2,575	
Lincoln Cosmopolitan	U. S.	123	4,248	152	3,240	
Mercury 8 with Overdrive	U. S.	118	3,387	110	2,032	
M. G. 1¼ Liter	Br.	99	2,180	46		22
M. G. TD	Br.	94	2,016	54		22
Morris Minor	Br.	86	1,582	27		33
Nash Statesman with Overdrive	U. S.	112	2,995	85	1,788	
Nash Ambassador	U. S.	121	3,550	115	2,064	
Oldsmobile 88	U. S.	120	3,531	135	1,978	
Oldsmobile 98	U. S.	122	3,750	135	2,299	
Packard 8	U. S.	120	3,515	135	2,249	
Packard Super 8	U. S.	127	3,570	150	2,633	
Packard 8 Custom Ultramatic Standard	U. S.	127	4,510	160	3,935	
Panhard	Fr.		1,034		1,390	46
Plymouth P-20	U. S.	119	3,068	97	1,566	18–19
Pontiac Chieftain 6 with Hydramatic	U. S.	120	3,405	90	1,745	
Pontiac Chieftain 8 with Hydramatic	U. S.	120	3,485	108	1,813	
Renault	Fr.				1,035	40
Riley 2½ Liter	Br.	110	3,136	90		21
Rolls-Royce Silver Dawn	Br.	120	4,704	150	14,000 up	14
Rolls-Royce Silver Wraith	Br.	127	4,704	150		14
Rover	Br.	111	3,024	75		21
SM 1500	Br.	107½	2,474	50		28
Studebaker Champion	U. S.	113	2,780	85	1,519	
Studebaker Commander with Overdrive	U. S.	120	3,255	102	1,903	18–19
Sunbeam-Talbot 80	Br.	97½	2,527	47		22

* Prices on foreign cars are quoted for delivery in New York City. Tariff, handling charges, and freight charges are included.

Prices on U. S. cars are for four door sedans at the factory, and it includes handling charges and Federal excise tax. Freight, charges, local taxes, and accessories are extra.

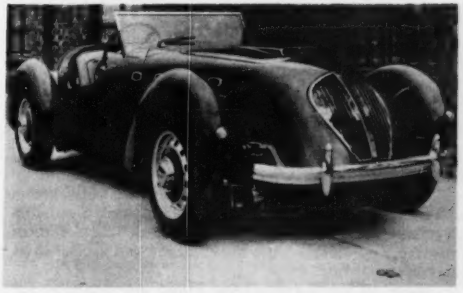
Nickel Topics

The Austin A90 with tear drop fenders, which are characteristic of many British cars.

However, if there is one thing the connoisseur of foreign autos knows, it is that the American car has nothing, really, to do with automotive romance. Time was when the American industry produced motorcars worthy of that description — the Duesenburg, a 320 hp. sports car of the '30's, the Cord convertible of 1937 with a front wheel drive and electric transmission, and the last one was the 1948 Lincoln Continental with a V-12 engine. But it is no longer so. In the unending tension which exists throughout the world between the convenient and the romantic, the American auto now wholly symbolizes the former. Much as he may admire the pragmatic virtues of Detroit, the foreign auto fancier will probably find that the American vehicle is somewhat of a concession to the sociology of a nation whose dominating females are noted the world over. Under the hood, for instance, and in chassis construction he will find little to engage his masculine delight in an exceptionally powerful engine and experimental engineering.

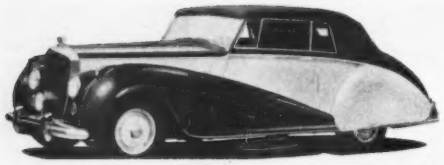
In short, if America dominates the automobile business of the globe, it is the Old World which has kept alive the romantic conception of the motorcar with the most vigorous engineering. Impractical — of course. How many people can afford to buy such cars? But who ever raised that objection with validity concerning works of art whether they be musical, sculptural, or mechanical? And so the Old World ideal persists.

Today the Olds 88 with its low ratio of weight per horsepower and automatic transmission gives a splendid acceleration performance, but the car is not capable of sustaining its maximum speed on other than a straight road. Then of course there is the old standby, the



Nickel Topics

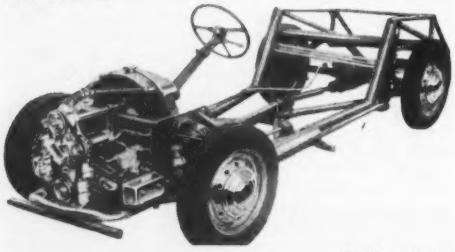
The Healey can be driven up to 110 mph with complete freedom from mechanical worry.



The Motor of London

A person can catnap on the back seat of a Bentley doing 90 mph.

worked over Ford V-8. Undoubtedly one of the major faults found with American automobiles is that they are not engineered to hold the road at high speeds. Most European cars, including those up to five hundred pounds lighter than the Studebaker Champion, are capable of maintaining speeds over 100 mph. on continental roads.



The Motor of London

A view showing the tubular construction of the chassis on the Jowett Jupiter.

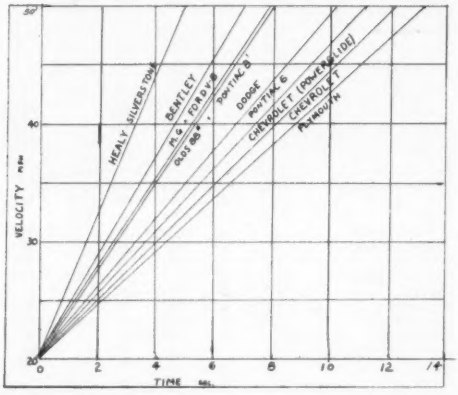
It is difficult for Americans to appreciate the degree to which the automobile engages the sentiment of Europeans. Each of the Grand Prix races — at least one a week all summer — attracts as much attention as the annual 500 mile classic at Indianapolis.

A note in *The Motor* of London reflects the heroism accorded by Italy to its veteran favorite, Tazio Nuvolari. Speaking of his ordeal in Italy's famous 1,000 mile road race it reads: "Superlatives exhaust themselves when it comes to that little man. Depressed by his family losses, suffering from poisoning due to alcohol-fuel fumes, a suspected t. b. case, and fifty-six years old, they thought Nuvolari was done for. . . . without any knowledge of the car (a Cisitalia), without any practice, starting, of course, in the middle of the night, Nuvolari drove like a maestro for the first 50 to 60 miles . . . then he cracked up physically and drove the rest of the 1,000 miles by will, determination and despair." Is it any wonder then that leading continental drivers have the status of baseball or football heroes in America?

Such emotion, gathered around automobilism, has traditionally been catered to by the production of the Old World's superlative sports cars and fastidious general-purpose automobiles. French and Italian roads are emptier than America's. It is frequently possible to open out a 100 mph vehicle, and sportsmen in crowded England resort to hill climbing and acceleration contests.

Many of the foreign cars which are designed for competitive use are available in America. These cars appear in the hands of sporting drivers at competitions held by various automobile clubs throughout the country. The Allard and Allard J2 fall within this category. Either model should be of interest to prospective buyers as the engine used is a Ford V-8, and many of the component parts used in the chassis also emanate from the Ford Motor Company. It is possible, therefore, for Allard owners to benefit from the world-wide Ford service which is available wherever they may go. The roadster, sedan, and convertible employ the standard 220 cubic inch Ford engine, while the sports-type J2 uses a Mercury engine. Although great power is available and almost unequaled acceleration owing to its very light weight, the gasoline consumption is not very high. Under exceptionally high speed driving, one can expect an average of fourteen miles per gallon. The J2 has four coil springs and a De Dion type axle; a method of construction which has been used most successfully on such famous racing cars as the Indianapolis Miller cars and the pre-war Mercedes-Benz.

The present model of the Aston-Martin, a British

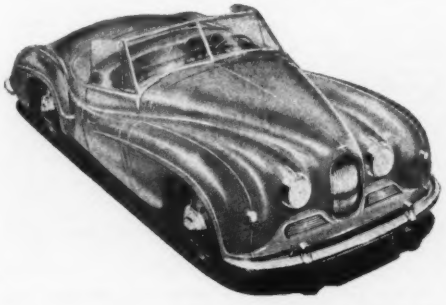


*With hydramatic drive.
[1]With high compression head, 7.5 to 1 compression ratio.

Graph showing time for various automobiles to accelerate from 20 to 50 mph.

car, was tested on the raceways of Europe. First the chassis and then the complete car was tested in two different, twenty-four hour races. The car equipped

(*Continued on page 24*)



The Motor of London

The Jowett Jupiter, a dashing convertible, seats three abreast.

m.i.t.'s psychiatric service

By Dr. Dana L. Farnsworth

Psychiatry has been much in the news and in our various media of entertainment in recent years, but there are still many M. I. T. students who do not know why a psychiatric service should be useful in an educational institution. The Medical Department has a psychiatric service made up of five psychiatrists, and if the number of interviews with them is any criterion, it is a useful service. But why should an educational institution made up of normal men and women have any use for the services of professional persons who specialize in emotional disorders? Many persons contend that if a student is able to stay in school and meet the exacting requirements of his various courses, he should be able to solve any emotional problem that may arise.

Unfortunately such is not the case. Evidence has been accumulating gradually over the past thirty years in numerous college health services to indicate that each year from ten to fifteen per cent of college students have emotional problems of sufficient gravity to call for psychiatric aid in their solution. Some of these problems are very disabling and may make it necessary for the student to withdraw from school either permanently or temporarily for treatment. Others are of less severity and can be solved with capable help without losing time. Probably the largest percentage of problems are those that cause some incapacity but which the student can work out more advantageously with professional help than on his own.

The symptom or conflict which causes a student to report for treatment bears practically no relationship to the type of problem that may be uncovered. For instance a student may come for consultation because he has been cutting classes for three weeks and the cause may be a complex conflict with his father. Another may complain of pain over the heart, and his problem turns out to be in the sexual sphere. Any disturbance of interpersonal relationships which results in anxiety may then give rise to one of the symptoms of anxiety, and these are many and varied in character.

What kind of problems or symptoms are indicative of emotional stress? The variety is indeed almost bewildering. Most of the symptoms are indicative of anxiety of one form or another. In a recent random sampling of one small section of patients representing a small alphabetical section, I found that students asked for help because of the following symptoms: poor adjustment, few friends, inability to get along with people his own age, compulsive drive to be meticulous; lack of interest in his subjects and inability to concentrate; cutting classes for three weeks; pain over the heart; severe conflict with his ill father; periods of moodiness and depression; lowered efficiency and day-dreaming; poor concentration; difficulty in studying; easy fatigability; lack of zest and episodes of depression; nervousness and poor grades; inability to decide whether to get married or not; stammering; episodes of depression and frustration; poor grades and poor spelling; severe periodic headaches; insomnia; excessive thirst; spells of discouragement and depression; inability to decide on a profession. In each instance the presenting symptom was indicative of a real need for help in solving the situation confronting the student. In none of the above cases was the student "crazy" (psychotic) and the problems differed only in degree from those of every student in the Institute. It is normal to have problems and natural and desirable for a student to attempt to solve them, but it is foolish not to seek help for those problems which interfere seriously with successful academic work or with satisfying living.

Many students have difficulty solving conflicts in interpersonal relationships, especially with their parents. The early college period and late adolescence usually coincide, and the student's struggle for emancipation and his desire to be considered on his own merits and not simply as someone's son or daughter frequently lead to rebellion in its various forms. Some students become discouraged and depressed, again largely from disturbed interpersonal relationships, and become very critical of the college and its educational methods. This does not imply that criticism of M. I. T. is a symptom of emotional instability but rather that unreasoning and bitter criticism frequently is such an indication. When a student becomes depressed, it is quite reasonable to expect some interference with concentration and memory, inability to make clear-cut decisions, impairment of sense of humor, easy fatigability and a strong tendency to depreciate one's own good qualities.

The rebellion mentioned previously frequently takes the form of lack of interest in school work. Such a student presents himself with the complaint, "I can't make myself want to work." He invents innumerable reasons why he should engage in this or that activity so as to put off the time of beginning his required school work. Such a student may have a very carefree attitude, his motivation is poor, and as a rule he thinks of himself and others think of him as just plain lazy. Sometimes when a student is in this frame of mind he becomes very sensitive to authority in any form. He is extremely critical of his parents, of the Institute, or of any person or institution who may be identified with authority. This form of rebellion may lead the student into greater and greater isolation, making him susceptible to the appeal of cults, eccentric religious orders, or ideologies whose main theme is protest against any and every established order.

Because the late teens and early twenties are the ages of transition to full sexual maturity, problems involving social relationships with the opposite sex are prominent. These problems usually have much more to do with faulty attitudes acquired in childhood than with any overt behavior of the student.

Psychiatric treatment or psychotherapy is the treatment of emotional disorders by psychological means. Its aim is to help the individual to adjust in a more satisfying manner to his environment. Contrary to the ideas of many people the psychiatrist does not try to help his patient to adjust to a low level of accomplishment; instead it is his constant aim to free him from conscious and unconscious conflict together with its accompanying anxiety in order that he may

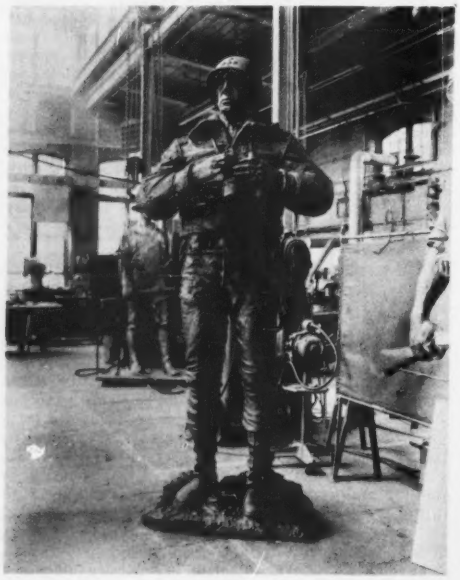
(*Continued on page 26*)

art in bronze

Ancient Methods of Statue Making Still in Use

By John Peterson, '54

The casting of bronze statues has become the traditional means of commemorating great men or deeds throughout the civilized world. It is a highly specialized work, for the finished statue must portray the full character of the model if it is to be completely effective. One of the most recent monuments to be constructed was that of Gen. George Patton. The Gorham Company of Providence, R. I. recently undertook the casting of a permanent memento to this man's courage. They have cast many of the more important statues of our times, including the famous "They that go down to the sea in ships."



The Foundry

General George Patton — a statue created by the Gorham Co. and recently unveiled.

Large bronze statuary figures, either single or forming a group, are made according to one of two methods. The first, called *cire perdu*, or the lost wax process, entails the use of wax to represent the thickness of the statue while the mold is made and dried. The wax is then melted out and replaced with the bronze. The bronze duplicates every feature of the lost wax, including the thickness.

The second method is the same as that employed by the ordinary jobbing foundry in the production of castings of the same general size and shape. A three part mold is used. The top part is lifted away and the core set. Then the top is replaced and the mold closed and the metal poured into it.

A good bit of work has gone on before either of these methods is put into practice, though. Having decided on a definite design the sculptor constructs a full size clay model supported on the inside by a framework of pipes or bars. This is called an armature. Over this armature a plaster casing is built up to form a mold for the plaster pattern which will go to the foundry. This plaster cast corresponds to the loam wall which the molder builds around the pattern in ordinary foundry practice. A thin coating of blue tinted plaster is then added and it is followed by thicker plaster poured into suitable rough wooden forms built so that they completely enclose the figure. Thin metal strips have been set into the plaster at convenient locations so that the mold may be taken apart and the clay armature removed.

The plaster molds are then thoroughly cleaned and the interior face painted with a solution of green soap to fill the pores and prevent suction. The mold is reassembled into small components for convenience and the inside is covered to a depth of about one inch with plaster. The green soap will prevent these two molds from sticking together. When the inside has hardened sufficiently the heavy outside is broken away. The thin layer of blue plaster will serve as a warning in this operation that the operator is nearing the face of the plaster mold. The statue will be cast in the same sections as those in which the plaster mold is now divided.

The method of placing gates in statuary and other ornamental bronze forms has not changed since it was first practised by the Greek craftsmen. Also the so-called Roman joint to join the several separate sections of a statue to form a smooth unbroken surface is still in use.

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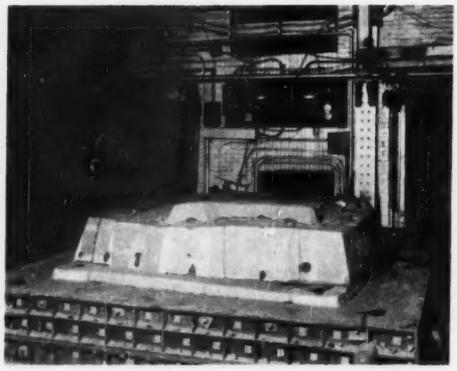


The Foundry

Even for casting statuary the molds are substantial. This one for the base of Washington's figure weighs sixty tons!

atmospheric dust

There Is the Ordinary Stuff, and Then . . .

By Dr. H. E. Landsberg, Research and Development Board

This article was delivered as a talk on March 22, 1950, during the General Electric Science Forum program — a weekly broadcast on Wednesdays from Schenectady, New York, over WGY (810 kc.) at 7:30 p.m.

Most people think that dust is just a nuisance to the housewife. They forget about it after a satisfactory vacuum cleaner has been added to the household equipment. Many of these same persons would probably consider it peculiar if someone would raise the questions: Where does the dust come from? What is it composed of? And what does it do before it settles on someone's window sill? Well, scientists are just the type of queer characters who will ask these seemingly silly and irrelevant questions. We shall presently see that there are many good reasons why the answers are of real importance.

Dust is always present in the air in larger or smaller quantities. In our day and age much of it is man-made, but actually nature contributes the major share of the dust in the atmosphere. The share attributable to human activity is by no means negligible. It is usually referred to as atmospheric pollution. Over the typical million-inhabitant American city over 2,000 tons of dust per year settle on each square mile. This type of dust, mostly composed of soot and similar combustion products, does not move very far from its point of origin. It has developed, however, into a menace to health and property. Its abatement has become a major issue in many localities. A great deal of research is being devoted toward the elimination of smoke pollution. Past studies have shown that the weather conditions are governing to a considerable extent the distribution and settlement of the smoke particles. Present research aims at two points. One is the elimination of the particles at the source by better engineering. The other is the controlled release of smoke in accordance with the prevailing conditions of diffusion and turbulence in the atmosphere. These atmospheric elements determine whether the smoke will safely disperse over a wide area or whether it will accumulate and settle near the source. We want just to mention this aspect of the atmospheric dust problem here in order to underline the practical importance of dust studies.

But, as I have already stated, nature is responsible for the greatest share of dust usually found in the air. Four important sources account for most of this dust. They are: soil blowing, oceanic spray, volcanic activity, and meteoric matter penetrating from the universe into the earth's atmosphere. Oceanic spray brings an enormous amount of salt dust into the air, after the water has evaporated. It has been estimated that this amounts to two billion tons of salt dust per year. It is dispersed into particles which measure only about 1/1,000,000 of an inch in diameter. It would take about a million billions of these particles to make up a pound of salt. These salt particles play a very important role in nature because they act as centers of condensation for the small droplets forming clouds. Without these, cloud formation and hence rain would be impossible. In fact, about 3,000 to 4,000 of these so-called condensation nuclei are needed per cubic inch to obtain a cloud even when moisture conditions in the atmosphere are otherwise favorable for cloud formation.

Soil blowing is another source of dust. Whenever strong winds hit an exposed top-soil during a dry period dust storms ensue. Many of us will recall vividly the situation in the Dust Bowl of Oklahoma, Kansas, and Colorado back in the years 1934 to 1936. The wind removed millions of tons of top-soil and deposited the dust often hundreds of miles away. In 1935 I had opportunity to make some observations on one of these storms in Pennsylvania, over 1,400 miles away from the source of the dust. This single storm deposited 25 tons of dust per square mile after it had travelled across half of the continent. Some of the most fertile soil of our present era is wind-blown and has accumulated over thousands of years of geological history. Climatic conditions at the southern edge of the great ice sheet, which covered large areas in the geological epoch preceding the present, were very favorable to dust storms. They formed some very thick deposits of dust, called *Loess*, which reach the thickness of 700 feet in some parts of the world.

The third natural cause of dust is volcanic activity. Many volcanic eruptions are accompanied by ejection of huge masses of ash. Within human memory the eruption of Krakatoa, in the East Indies, was probably the most spectacular one. It took place on August 26 and 27, 1883. It is estimated that this eruption threw about four cubic miles of dust into the air. This dust was carried into the high layers of the stratosphere and stayed there for two or three years, travelling many times around the globe before settling. Similarly large masses of dust were produced also by the eruption of the volcano Katmai in Alaska, in 1912. Some scientists believe that these enormous dust masses intercepted so much solar radiation that they were responsible for particularly low temperatures in the year following the eruptions. The late Dr. W. J. Humphreys, one of the great meteorologists of the century, speculated on the basis of this evidence that the great pleistocene ice age may have been brought about by a long series of volcanic eruptions.

We can summarize our discussion up to this point that the small atmospheric dust specks really play a big role in nature. The wind may pick them up as soil particles and shift fertile farm land from one place to another. Salt dust ripped from the breaking waves of the ocean is a necessity for the formation of cloud and rain. Volcanic dust belched from the hot depths of the earth may be responsible for climatic changes.

No such spectacular effects can be attributed to dust derived from the fourth natural source. That is the dust impinging on the earth from outer space. But this type of dust is perhaps the most intriguing to the scientist. One reason is that it is quite elusive. The first intimation that dust from the universe may find its way into the earth's atmosphere came from the famous British Challenger expedition. This expedition

(*Continued on page 30*)

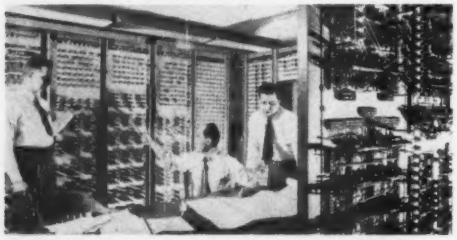
"giant brains"

. . . . Engineers of the Future

By Bob Redick, '53

It would be impossible to completely separate the evolution of *Giant Brains* and the evolution of man himself, for the former is a result of the latter, and the probability that the future will bring about to some degree the reverse of this relationship is very high. In comparing the man of today with the Neanderthaloid man of yesterday, marked differences are immediately apparent, but these differences are not physical. Many thousands of years have brought no significant increase in the bodily ability of man, nor are his hands more capable now than those which once threw sharpened stones at fleeing animals. Only the mentality which controlled those hands has changed. Rightly, then, the evolution of man can be considered as the evolution of his mind. If we trace this *mental evolution* it will be found that we are also tracing the evolution of *Giant Brains*, and it will become more and more apparent that the ultimate development of machines that could "think" was inevitable. Moreover, when the past is known the future becomes clearer, and it is possible to predict to a great extent many future implications of these *Giant Brains*.

Probably the greatest factor involved in man's mental evolution was the advent of *artistry* and *symbologies*. Crude pictures representing the composer's perception of his environment were scratched upon stone walls. Later these pictures became more numerous and complex, and represented ideas and concepts



General Electric's digital calculator, OMIBAC, which supplies answers to complex mathematical problems at a speed five thousand times faster than a human.

which could be passed down from generation to generation. Man never would have evolved from his early primitive existence had he not been able to learn and profit by the experiences of his forebears. As time passed, symbols in the form of a written language gained ever-increasing importance, and pictorial representation was pushed into the background as too inadequate to represent ideas. Now that communication was well on its evolutionary way, however, the time was ripe for the development of a new aid to man's mentality. This new idea was mathematics, and following the same pattern as had communication, started with pictorial representation. Geometry was man's first attempt at understanding his environment quantitatively. This alone was enough to enable him to build architectural structures that without some form of mathematics would have been impossible. Underlying this geometry was a basic principle that continued to evolve outside and beyond pictorial representation of distances and angles, and this was the use of representative *physical quantities*. This continued development manifested itself in the form of computing devices which relied upon physical quantities of one sort or another for their functioning. The slide-rule is exemplary of these devices, for it adds and subtracts lengths, which are basic physical quantities. Devices such as these were given the name *analogue computors*. Many other physical quantities than distance have from time to time been used in analogue machines, such as the amount of turning of a shaft. The speedometer of a car, for instance, uses the amount of turning of a wheel, and some electrical properties to tell distance traveled and speed. The speedometer is in the broad sense of the word an analogue computing machine.

Electrical quantities too may be used for computing purposes. A product xy may be evaluated by adjusting a variable resistance to have the value x ohms, then adjusting the current through it to have the value y milliamps., and measuring the potential difference across the resistance in millivolts. This potential difference, as can readily be seen by referring to Ohm's Law, is equivalent to the required xy product.

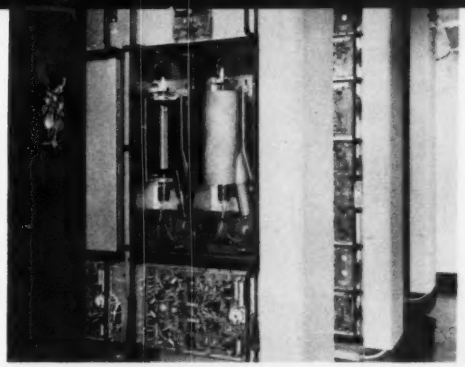
The biggest and cleverest mechanical brain of the analogue type which has yet been built is the *differential analyzer* finished in 1942 at the Massachusetts Institute of Technology. The fundamental physical quantity used in this machine is the amount of turning of a shaft. The name *analyzer* means an apparatus or machine for analyzing or solving problems. It happens that the word "analyzer" carries the meaning "analogue" as well. The word "differential" in the phrase "differential analyzer" refers to the main purpose of the machine: it is specially adapted for solving problems involving *differential equations*. During World War II, the aiming and firing of guns against hostile planes was done by machines similar to M. I. T.'s differential analyzer. After radar had spotted a plane, these machines would calculate firing instructions which would then be fed to the gun's automatic aiming devices. These analogue machines were called *fire-control instruments* and were constructed of steel and electrical parts built to fine tolerances. Analogue machines are exceedingly valuable in many uses but unfortunately they also have many limitations. Their factor handling capacity is small and the accuracy obtainable generally reaches its limit at one part in ten thousand. Usable physical quantities are just not measurable to any greater extent.

Now that the evolution of picture writing, or representative physical quantities has in part been traced, it is possible to return to *symbologies* and likewise trace their path up through time to the present. It will be realized that symbologies are characterized by *configuration* rather than representative quantity, and as such are more abstract. Symbols and permutations of these symbols are devised, then defined to represent

certain information. Each written word is just one permutation of the twenty-six letters in our alphabet; millions of these permutations are possible, each one different. If we devise our own alphabet, for example, containing only three letters, *a*, *b*, and *c*, and further decide that no word can have more than three letters, it is possible to form thirty different words. Suppose now a slightly different system is formulated in which there are ten letters. With them we can make up any number of different permutations. This is exactly analogous to our system of decimal numbers, for instead of using "a" through "j," we could just as easily use zero through nine. It is evident that many symbologies could be devised, but there are factors involved that make some particularly suitable for specific purposes. Theoretically, for instance, our numerical system and alphabet could be interchanged, but since we have twenty-six sounds to represent, it is more practical to use a symbology with twenty-six symbols.

In any case, as mathematics came into being, various symbolic systems were devised to represent quantities rather than words. Processes by which these symbols could be manipulated according to geometric principles were developed too, and mechanical devices were invented on which it was possible to *count* these "numbers." These were called *calculating machines*. The first of these devices was the *abacus*, consisting of beads strung on rods and placed in a frame. Its function was only that of a recording medium and not that of actually calculating, but in the broad sense it is considered a calculator for there is no doubt that it was a forerunner of our modern *Giant Brains*. Commencing in the late 1800's, *desk calculating machines* were constructed to meet mass calculation requirements. They would automatically add, subtract, multiply, and divide specific numbers with great accuracy and speed by the use of notched wheels, levers, and gears. Beginning in the 1920's, a remarkable change took place. Instead of performing single operations, machines were developed to perform chains of operations with many kinds of information. One of these was the *dial telephone:* it could select one of seven million telephones by successive sorting according to the letters and *digits* of a telephone number.

Before continuing to trace the development of these calculating machines any further, let us first decide upon a few desirable qualifications for such a machine, then see how these qualifications evolved into a reality. The goal that we are seeking is a completely automatic *digital calculator;* this means that there are certain fundamental operations and functions that must be built into a single machine. It is necessary first of all that this machine have a memory that can not only remember the problems, the answers, and intermediate steps of calculation, but will also store more permanent information like tables of mathematical functions. This machine must be able to perform certain predetermined operations on the data which is stored within its memory, and furthermore must be able to automatically control the sequence of these operations. In analyzing the problem, it is realized that each memory *element* must have the possibility of existing in any one of ten different states corresponding to zero through nine. Switches, relays, or counter wheels with ten positions would accomplish this. Sequence of operation could be controlled by punched holes in paper tape, and mathematical functions could be recorded on punched paper cards. A calculator using these elements would be electro-mechanical in operation, for while the computations are basically mechanical, they are controlled by an electric "nervous system."



MIT's Whirlwind Calculator showing memory tubes in their associated apparatus.

The first major attempt at this goal was made back in the nineteenth century when an English mathematician and actuary, Charles Babbage, designed a machine — or *engine* as he called it — that would carry out sequences of mathematical operation. In the 1830's he received a government grant to build an analytical engine whereby long chains of calculations could be performed. But he was unsuccessful, because the refined physical devices necessary for quantities of digital calculation were not yet developed. Only in recent years did these physical devices become sufficiently versatile and reliable for a calculator of hundreds of thousands of parts to be successful. One of the first was the machine in the Computation Laboratory at Harvard University called the Mark I, or the *IBM Automatic Sequence-Controlled Calculator*. This machine does thousands of calculating steps one after another according to a scheme fixed ahead of time. This property is what gives the machine its name *automatic*, since individual operations are automatic, once the punched tape fixing the chain of operations has been put on the machine, and *sequence-controlled*, since control over the sequence of its operations has been built into the machine. It is perhaps not surprising to learn that this machine has more than 760,000 parts, but that there are only seven main kinds of parts. They are: wire, two-position switches, two-position relays, ten-position switches, ten-position relays, buttons, and cam contacts. The machine is really a very advanced stage of the desk-calculator, but because of its complexity, it is referred to as a *mechanical brain*. So, between taking in information and putting out information, the machine does some "thinking," but it does this thinking according to instructions. The instructions go into the machine as: (1) the setting of switches, or (2) the pressing of buttons, or (3) the wiring of plugboards or (4) the feeding in of paper tape punched with holes. Multiplication on the Mark I takes at the most six seconds; division averages eleven seconds. This is not a tremendously fast speed for these operations, but since no time is lost *between* operations, results of a problem are obtained very quickly. Accuracy is obtainable, too, up to twenty-three digits, something an analogue machine could never have. Everything considered, this machine is efficient and well-balanced. Its reading and writing speed (input and output) is close to its calculating speed. It can punch or print a result on the average for every ten additions or one and one-half multiplications. The memory of seventy-two numbers in the machine is extremely useful; a smaller memory is a serious limitation on the achievements of a computing machine. The machine can do many kinds of arithmetic and logic. It is well educated and can compute auto-

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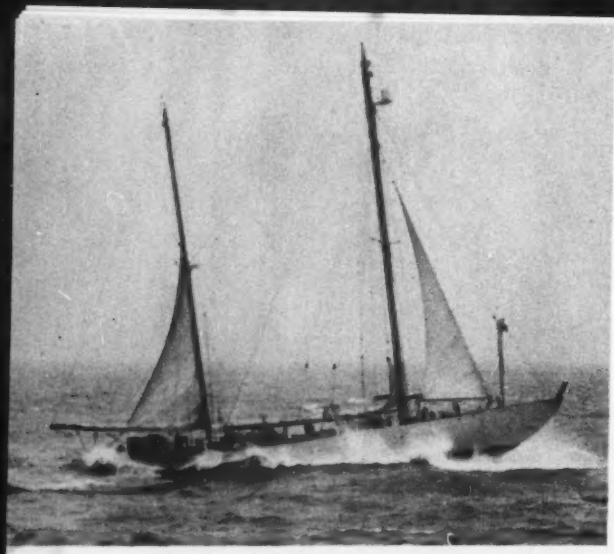


Canadian Naval Research Establishment

***R. V. Atlantis* at sea. The oceanographer must be able to work on a "moving platform" and do his thinking at sea to guide his actions and the ship's course. People on board *Atlantis* thought it was a calm day when this photograph was made.**

Science

A Little Known Field in the Spotlight

By Bert Krauss, '54

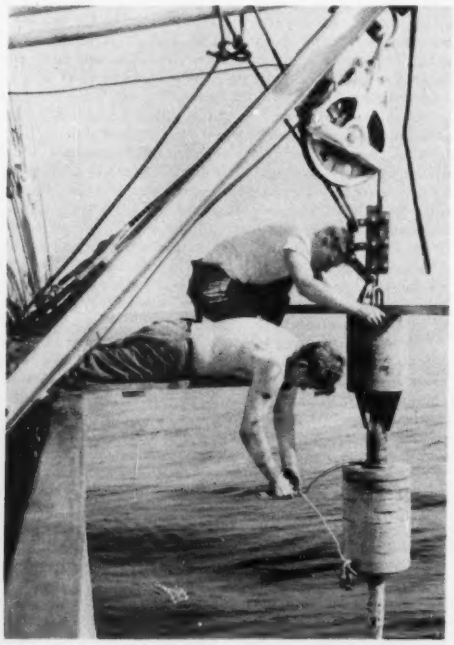
Oceanographers study the ocean, naturally enough, but they are trained as physicists, chemists, and biologists. There aren't many of them; in fact, there are only about three hundred active in the field at the present. There are also some eighty graduate students.

Research is carried on mostly by government laboratories such as those of the Hydrographic Office, the Meteorological Survey, the Geodetic Survey and the Fish and Wildlife Service. Some universities, notably Washington and California, have laboratories.

Probably the largest of the laboratories in the country is the Woods Hole Oceanographic Institution at Woods Hole, Massachusetts. A privately endowed institution, Woods Hole has two ships, the *Atlantis* and *Caryn*, in addition to extensive shore facilities. Woods Hole engages in hydrographic and geological surveys, as well as bacteriological and fish resource studies. Actually the work falls into two groups, geophysics and ectology. The former deals with the relationship of the ocean to its boundaries: the ocean

A forty to fifty feet long coring tube is adjusted before it is lowered to obtain a long core of sediment from the ocean bottom. Dr. Maurice Ewing of Columbia University is doing the stretching exercises.

Woods Hole Oceanographic Institution

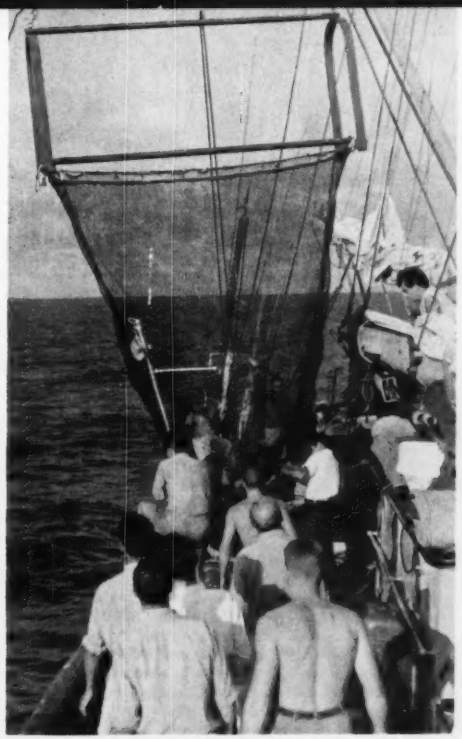


Woods Hole Oceanographic Institution

Although most of the data acquired at sea are worked up in the laboratory at Woods Hole, a certain amount of work is done at sea. Here, Dean Bumpus, oceanographer, determines the positions where observations were made. The luxuriant growth was the product of six months at sea. The growth has since gone the way of all sea-grown beards. They do not seem to thrive on land.

Woods Hole Oceanographic Institution

Lowering a Nansen bottle to obtain water samples and temperatures to establish the density distribution in the ocean.



Woods Hole Oceanographic Institution

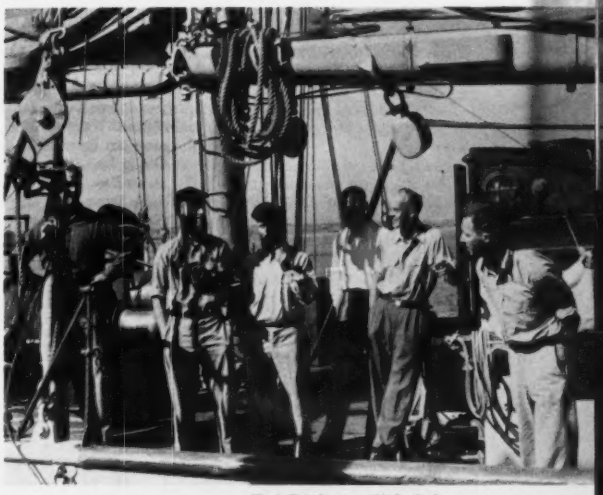
A deep-sea trawl net is ready to be lowered. Some of the heavier equipment can only be used during good weather. For this reason *Atlantis* usually works in the northern North Atlantic during the summer and in the Caribbean or Gulf of Mexico area during the winter.

at Sea

floor, the atmosphere, and the shore. The ecologists study the environmental factors concerning marine life.

The oceanographer cannot make use of carefully controlled experiments. He must meet conditions as he finds them at sea. He analyses the observed conditions into the several processes of which they are the combined effect.

Like many other scientific fields oceanography was stimulated by wartime heads. For instance, the armed forces required meteorological information in planning sea movements. The expansion has not ended with the war. While oceanography will never equal in size most other scientific fields, it is an active science requiring active, virile workers.



Woods Hole Oceanographic Institution

After a six and a half months voyage on *Atlantis*, the scientific party is glad to be back in Woods Hole

tech engineering news

Professional Journal of the Undergraduates of the
Massachusetts Institute of Technology

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from the editor's notebook

President Killian Speaks...

Following is an abstract of a speech given by President Killian of M. I. T. to the entering class on September 17, 1950. It would seem that this is a late time to publish it, but it will be apparent to you that it is timeless in its worth and universal in its application. It's good sense.

My hope for you is that your years in college, taken in the round, may be not just a task but an exhilarating and joyous experience. I am sure that they can be if you avoid cynicism and indifference and purely selfish objectives. If you are receptive and open-minded, active and not passive, it can be a matchless experience.

Why is this true? As an undergraduate, you are living in the nearest approximation to a Utopian community that you will ever find. A college, if it is good and yours is, is so contrived that every part of it seeks to encourage, through you, your growth and well-being. Colleges, I hasten to say, are not perfect communities; wherever people are gathered together there will be some pettiness, selfishness, and frustration. These are minimized, however, in a college community, and I think that you will find more good will in college than in any other human situation outside of a happy home.

Since the setting and conditions approximate the ideal for living and learning, it is important to take advantage of them to the hilt, to share fully in every part of college living that can contribute to your development. By living generously, even boldly, under these conditions you can have the magical experience of which I speak, the exhilaration of free flight.

The fact that college is an oasis designed for your benefit places you under special responsibilities. You must realize that being in this oasis is a privilege and not a right. You must remember that the earnings and labor, the striving and the imagination of many people have made it possible for you to benefit from the institution. The obligation that this places upon you is that you must accept your responsibility for keeping it an oasis.

We believe that a man demeans his college education if he looks upon it solely as a means to increasing his earning power.

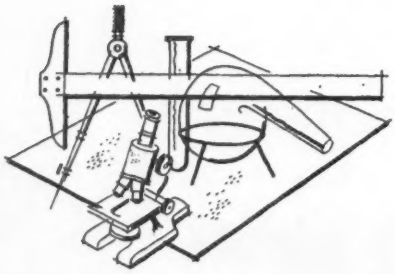
Essentially a college is a group of people with a common aim, a "company of scholars," and the effectiveness of this community depends upon the quality of the people in it and their willingness unselfishly to work for the common good. I have confidence that you will do this, but I still want to stress the importance of living altruistically in college. This is the only fitting way to live in a community that must be altruistic if it is to minister to the mind and spirit. Someone has said that "education is learning to hang up your own towel." It is also learning to hang up your roommate's towel.

I hope for you that you will accept your share of community responsibilities, that you will participate successfully in extracurricular activities, and that you will do both of these, not for purely competitive and selfish reasons, but because you come to have a love for your college and a loyalty that will make working for her something more than a duty.

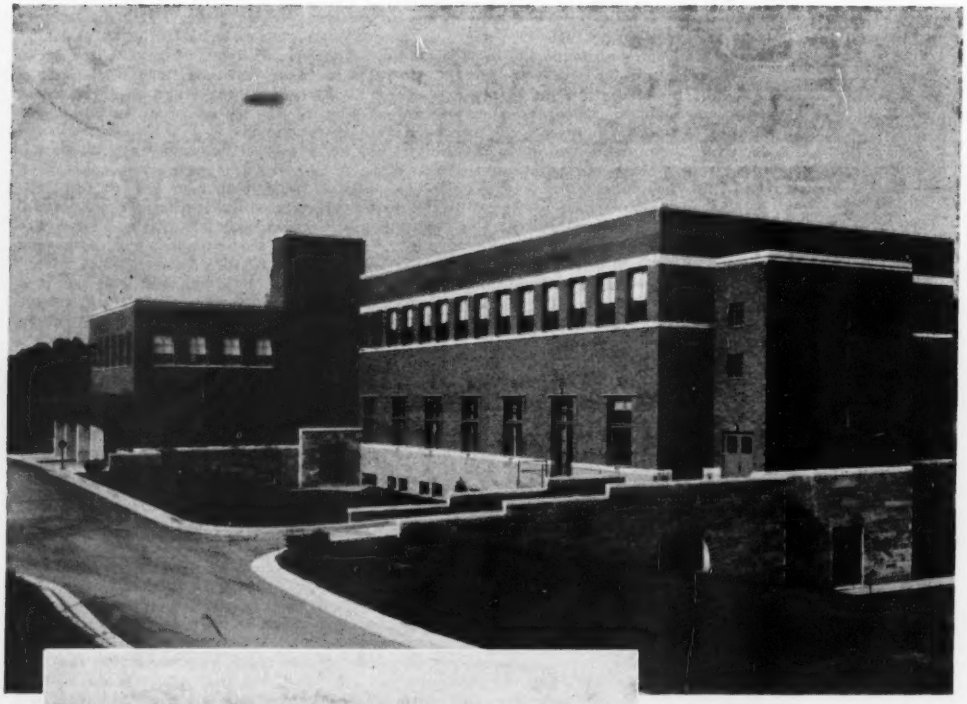
The experience of living with a highly selected group of people having similar objectives and capacities but differing points of view and backgrounds can be in itself a formative educational experience. Your outlook and point of view can be tested and matured by the interchange and clash that come from bull sessions and all your living contacts. I hope that you will participate in much of this searching and tolerant kind of talk that comes in the late hours when the mind runs free. It is certain that you will if you don't insist on going through college with a set of ready-made ideas and an unwillingness to try out new ones. All of this means that you must center your interest in the college community.

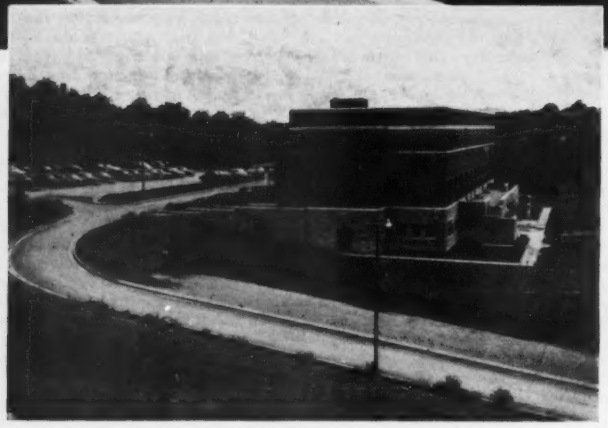
I would hope that you can concentrate sufficiently so that you have the satisfaction of gaining some mastery of a field. Above all seek understanding. What someone has called the "court-plaster or sheep-dip" method of college training is the curse of too many colleges. I would also hope that you will gain breadth along with acquiring depth. Some of this breadth will come from the courses you take and the teachers you come to know well. Most of it you must acquire yourself, out of an unremitting curiosity, by reading on your own both books and people. I hope some of your teachers will have the genius to set your mind on fire, to open wholly new vistas and to communicate to you deeply moving enthusiasms.

(*Continued on page 38*)



Dedicated to





The new home of the Westinghouse Educational Center where new employees from engineering colleges receive an orientation and training program to help them find the kind of work they like to do and are likely to do best. Hundreds of experienced professional people help carry out this program. A Graduate Study Program is also made available through which advanced degrees may be obtained.

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Building solidly for tomorrow is an important phase of modern business . . . building men for positions of leadership.

For more than half a century, Westinghouse has placed major emphasis on this activity . . . pioneering in student training . . . graduate study courses . . . encouragement of scientific training through scholarships and fellowships . . . and in many other ways.

Now we dedicate an entire new building to this purpose—the Westinghouse Educational Center—a building devoted to the self-improvement of men . . . dedicated to developing leadership.

Here, top students who are recruited at leading engineering schools for positions in engineering, manufacturing, sales and research, come for an orientation and training course that provides their first intimate view of the electrical manufacturing industry . . . and the varied opportunities it offers.

Every facility has been provided to help these men get off to a firm, fast start . . . modern class rooms equipped for visual education . . . a large auditorium with complete stage and projection room facilities . . . and a large, comfortable library and study hall. Here an intensive course of study is given by engineers and scientists who are top-ranking men in their fields.

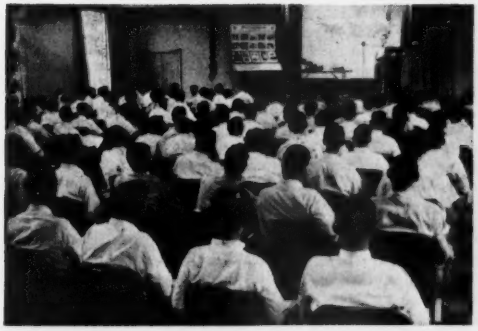
These same facilities are also adequate to take care of the needs of post-training-course employees who are participating in the Graduate Study Program and the many other educational activities of Westinghouse.

For their convenience and comfort, there is a cafeteria and generous space for formal and informal gatherings. For relaxation and recreation, there are hobby, billiard and game rooms and outdoor recreation facilities.

Here, then, is a building dedicated to developing leadership . . . that priceless asset of a strong organization . . . able management and professional leadership for tomorrow. Another reason we say with confidence . . .

G-10116

YOU CAN BE SURE..IF IT'S Westinghouse



Aided by the most modern facilities, experienced professional people provide a panoramic view of the research, engineering and manufacturing that go into Westinghouse products and the techniques used in marketing them.

In planning the new Educational Center, careful thought was given to recreation. A spacious lounge, hobby and game rooms, a billiard room, facilities for indoor and outdoor sports along with a convenient cafeteria—all contribute to a well-rounded program.

You can
AFFORD to use
CASTELL
world's finest drawing pencil
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CASTELL lead now!
Why wait until you graduate? Start using the Drawing Pencil of the Masters today—smooth, free-flowing, grit-free CASTELL, accurately graded in 18 unvarying tones of black, 7B to 9H.
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Ask for CASTELL at your book store. Don't allow yourself to be talked into using a substitute. CASTELL is a life-time habit for up-and-coming Engineers.
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the strange power of the mind (*Continued from page 7*)

the ability; and/or he has become so saturated with the tests that he has become unable to concentrate effectively. Or, he may simply have lost interest.

One might well ask if the percipients could do anything to increase their scoring ability. Experiments have shown that the only thing they can do is to increase their ability to concentrate.

Another interesting observation is that among the families of the major ESP subjects there have occurred almost all of the usual run of psychic phenomena-precognitive dreams, apparitions, etc. This suggests that if ESP ability exists at all it is a normal faculty and that it is the lack of score-lowering inhibiting or restricting factors rather than the "ability" per se which is inherited.

If we assume that ESP does occur there are numerous hypotheses prevalent to explain it. However, none of them stand up in the light of present-day knowledge, mainly because they all fail to explain both telepathy and clairvoyance satisfactorily. The interested reader is referred to any one of a number of books on ESP, most of which contain at least one chapter on theories of ESP. If we assume that ESP does not occur, there are several ways to explain the results obtained in the experiments. A few of these follow.

Professor Richet thinks the results obtained by Rhine can be explained by the operation of a hidden "sixth sense" known as cryptesthesia. There are several reasons why this hypothesis seems illogical and therefore useless. First, no subject has ever experienced any localization of reception, as is the case with sensory perception. Second, the results of the long distance experiments would require an abnormally powerful sixth sense. Third, the results of pure telepathy experiments cannot be explained by such an hypothesis. Hyperesthesia, or acute development of one or more of the usual sensory abilities has also been suggested. Again, the results of the long distance experiments and the extreme precautions taken by Rhine to exclude the use of any of the five senses make this hypothesis untenable.

Professor Kellog of McGill University claims that Rhine is wrong in recording only the scores of subjects with outstanding ability. He says that if all the scores, including those of subjects who could rarely or never score significantly above chance, were averaged together the below-chance runs would compensate for the above-chance runs to give an average which could be attributed to chance. This sounds logical but how can it explain the fact that the subjects can score way *below* chance when asked to do so.

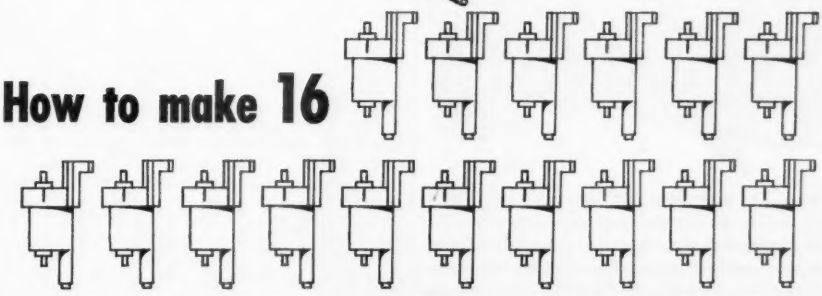
Incorrect statistical analysis and clerical errors have also been suggested. Suffice it to say that competent mathematicians have examined Rhine's methods of statistical analysis and have stated that if there is anything wrong with his work it is *not* in his mathematical methods. As for clerical errors, it is unlikely that they would *always* be made in such a direction as to increase the evidence for the existence of ESP.

Finally there are those who accuse Dr. Rhine and his co-workers of deliberate fraud. However, academic persons have seldom if ever been found to work a deliberate hoax involving hard work and long hours for many years.

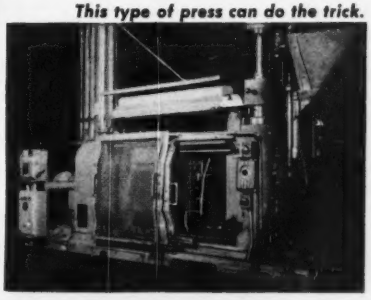
It would seem from the foregoing that ESP cannot logically be ascribed to fraud, etc. There must be something to it, even though we do not at the present time know what it is. Perhaps further research will provide the answer. Here at Tech the Psychic Research Society has been organized to carry on research in the field. Interested persons should come to the society's meetings, especially if they have any ideas for experiments. Experiments can also be performed at home. Either buy a deck of ESP cards — they can be gotten together with score sheets from Duke University, Durham, North Carolina — or improvise from a standard card deck. By all means take every precaution to exclude sensory perception. Remember that many trials are necessary before accurate conclusions can be drawn. If you want to test for psychokinetic ability, try tossing a coin a few thousand times and see if you can make it come up all heads or all tails. Of course you won't be able to accomplish this feat unless you have unusual abilities, but you might nevertheless get quite significant scores. Those to whom the rattle of dice is sweet music should roll dice a few thousand times and try for all sixes or sevens or what have you. Try it sometime. The results may surprise you. By all means contact the society if you think you have unusual ability.

Newsworthy Notes for Engineers

How to make 16 at the cost of 1...



This type of press can do the trick.



These odd looking little gadgets, called "pawls," go into high speed telephone dials used by Bell System operators.

Until recently, pawls (like the black one) were made of molded rubber with a steel pin for the shaft. They did their job well and lasted a long time. But Western Electric engineers decided to try to make them at a lower shop cost.

The engineers came up with an idea—mold the pawl, pin and all—in one piece of nylon. They made some samples—tested them thoroughly—found the nylon pawls would last as long and perhaps even longer in service. Bell Telephone Laboratories tested them—and approved. So Western Electric engineers tackled the production problems—designed new machinery for molding pawls in one piece. It wasn't easy—because all dimensions had to be controlled with extreme accuracy. But today the new nylon pawls are being made in quantities—*sixteen of them for the cost of one of the old type!*

This story of cost reduction—and there are scores of others like it—shows one way that Western Electric engineers help to keep down the cost of equipment produced for Bell Telephone companies and, therefore, the cost of service to telephone users.

Western Electric

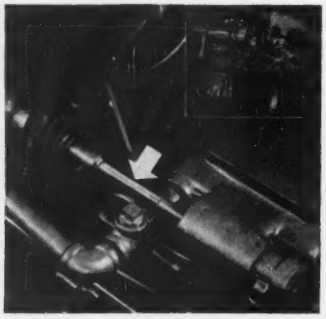
A UNIT OF THE BELL SYSTEM SINCE 1882

Engineering problems are many and varied at Western Electric, where manufacturing telephone equipment for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical, industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.

PROBLEM — You're working out the application of a hydraulic speed selector system to a turret lathe. The system's oil pump is to be driven by a belt take-off from the main belt drive. Your problem now is to provide a means for transmitting power from the pump drive pulley to the pump that will permit the adjustment of the pulley to regulate belt tension. How would you do it?

THE SIMPLE ANSWER — Use an S.S.White flexible shaft between the pulley shaft and the pump shaft. As you see below, that's how the Gisholt Machine Co., did it. An S.S.White flexible shaft is the logical answer for a wide range of drives where one or both of the connected members must be adjustable in position.

Photos courtesy of Gisholt Mach. Co. Madison, Wis.



This is just one of hundreds of power drive and remote control problems to which S.S.WHITE FLEXIBLE SHAFTS are the simple answer. That's why engineers will find it helpful to be familiar with the range and scope of these "METAL MUSCLES"* for mechanical bodies.

*Trade Mark Reg. U.S. Pat. Off. and elsewhere

SEND FOR BULLETIN 4501

It gives basic information and engineering data about flexible shafts and their many uses. We'll gladly send you a free copy on request.

S.S.WHITE INDUSTRIAL DIVISION
THE S. S. WHITE DENTAL MFG. CO.
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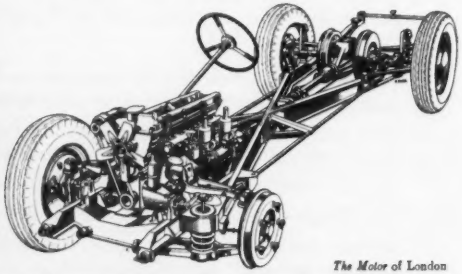
One of America's AAAA Industrial Enterprises

foreign automobiles

(*Continued from page 10*)

with the present-day chassis was victorious in the arduous race. Thus the manufacturers have made sure that every possible flaw was eradicated before the car reached the production stage. All this care, and the tradition of seeking perfection bred by participation in racing, has produced a car faster than anything built in the United States despite an engine of only 153 cubic inches as compared to 320.2 for a Buick Roadmaster equipped with dynaflow drive. The reason is that unlike so many cars, the body is really streamlined for speed, as distinct from many which are misnamed "streamlined" by the dictates of fashion.

The products of the Healey organization have won the Touring Car Category in the Italian 1,000 mile race last year and the Team Prize in the Royal Automobile Club's Production Car Race. A two seater, ultralight competitive model, called the Silverstone, has a four cylinder, overhead valve engine which develops 103 brake horsepower at 4,500 rpm. This car has obtained a speed of 111.8 mph, and it is capable of delivering 28.8 miles per gallon at 60 mph. The Jaguar XF120, although a new model, has already earned fame by the amazing speed it has achieved. When tested by a factory driver, the car averaged 132.596 mph over a distance of one mile; and when tested later by technicians from *The Motor* of London, it averaged 126.8 mph. These speeds definitely place the Jaguar at the top of the list among cars claiming to really go



The Motor of London

A view which shows the true X-frame and built-in rear brakes of the Lagonda.

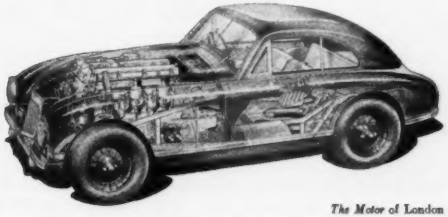
fast. Its outstanding performance can be attributed to its low ratio of weight per horsepower. It is equipped with the same size power plant as a Cadillac but weighs only 2,464 pounds as compared to 4,036 for a Cadillac.

Broadly speaking, performances in foreign cars mean energetic qualities which can be measured by speed, acceleration, and endurance tests. The consumers of foreign autos expect all these factors, regardless of the engineering design of the car. Just as Swiss watches are legendary for their mechanical refinements, so the foremost foreign automobile makers have great reputations to uphold. Precision work, for instance, is often carried to the point where the need for gaskets is eliminated.

Foreign automobile engines, in general, are much smaller than American engines, yet they develop as much and in some instances more power. The Alfa Romeo engine is six-tenths the size of a Buick Special engine, yet it produces nine-tenths the power that the Buick does. With a displacement of 149 cubic inches, three carburetors, and two overhead camshafts, it

delivers 100 brake horsepower at 4,800 rpm and propels the Alfa Romeo Sper Sports Model at a guaranteed speed of 107 mph.

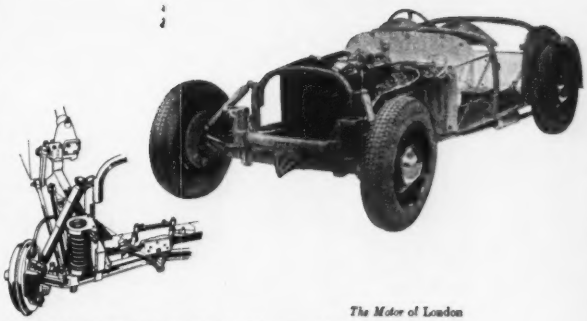
The excellent road-holding qualities found in European cars depend on a high ratio of sprung weight to unsprung weight, which is promoted by independent suspension. The elimination of axles removes what normally are the heaviest unsprung members. Independent springing may be accomplished by leaf or coil springs, or torsion bars whose springing function, like that of coil springs, lies in their twisting properties. There are substitutes for the conventional driving axle. In independent rear suspension the differential is rigidly attached to the chassis and usually drives the wheels through two independent half axles which are hinged with universal joints on both sides of the differential and at each wheel. Another important factor in the roadability of an automobile is that there be no excessive overhand on the back end. Practically all of the smaller and lighter English cars have had their engines moved forward so that designers have been able to reduce or completely eliminate any excessive overhang which existed. They also have independent, front wheel suspension which has given them remarkable smooth riding qualities over the roughest of surfaces, even if high speeds are indulged in. The drawing on page 24 of the Lagonda clearly shows the unorthodox chassis construction used throughout. It employs independent suspension on both the front and rear, and the frame is of a true X formation. It has been reported by a severe technical critic that this combination gives the smoothest ride yet achieved.



The Motor of London

A sectional view of the Aston-Martin, which is streamlined for speed.

In the small car category, foreign auto manufacturers offer many models which are well suited for a second car. The Austin A90 was especially designed for marketing in areas where convertibles are popular. The windows and top are power operated. The low price of $1,480 delivered in New York City is explainable by Austin being the largest and most efficient one-make production plant now operating in Europe. It is this model which last year broke many stock car records at the Indianapolis speedway. Despite conditions varying from almost tropical heat to a snow and ice-bound track, the Austin kept steadily on to finish the long run with sixty-seven records to its credit. The records have not been broken by anyone since. Austin dealers are to be found almost everywhere in Canada and the United States. They carry parts at a standard price and have factory trained mechanics. The Ford organization in England makes two models, the Prefect and Anglia, the latter selling for $998 in New York City. Like other cars in this group, it is economical to run. It averages thirty miles to the gallon, and the cost of replacing such items as tires is much cheaper than those required by the standard size American car. These



The Motor of London

The Allard J2 with the lively Mercury V-8 designed especially for competitive use. The inset shows a closeup of the front suspension of the Allard.

factors and the availability of service from the nation-wide chain of Ford service stations makes either model an ideal second car.

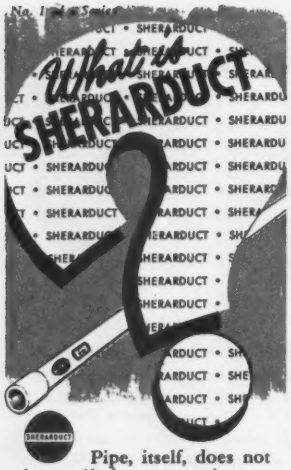
The English Hillman is a light car which follows the American design. It has a one-piece, curved windshield, the body work built out to the full width of the frame, and a surprising amount of trunk space. The Morris Minor, although a small car, has a large and well placed passenger compartment. Probably its most notable characteristic to the average motorist is its amazing economy in gasoline. The figures achieved regularly by owners and independent testers varies between thirty-three and thirty-five miles per gallon. While the problem of reducing gasoline costs is not a serious one in America, it should be remembered that a truly economical car should make it possible for families or individuals who could not previously afford to run a car to do so now. Naturally with such a fuel consumption figure, the Morris Minor has neither the power nor the performance of the average American car; but the excellent consumption figures have not been obtained just by cutting down the size of the engine. Instead, clever reduction in weight and wind resistance offered by the body have been made.

The Jowett Jupiter and Nuffield's M. G. Midget are two British cars which should be very popular with sports enthusiasts. The Jupiter has a four cylinder, horizontally opposed engine with two carburetors and delivers 60 brake horsepower. Although the engine is

(*Continued on page 36*)

Nichol Topics

The clean lines of the Hillman are apparent.



Pipe, itself, does not have all the properties required of a true electrical conduit. But National Electric processes a *special* steel pipe into a real quality conduit—Sherarduct.

Here's how:

1. Special high-grade steel is Spellerized—a kneading process that produces fine, even-textured steel.
2. The Spellerized steel is rolled into pipe, put through the Scale-Free process and pickled.
3. This specially treated pipe is Sherardized—an exclusive process of galvanizing that applies zinc to metal under heat. This affords permanent protection against rust.
4. A smooth "Shera-Solution" enamel is baked into the pores to give acid-resistant surfaces.

Then—and only then—do you have Sherarduct, a true conduit . . . long lasting, easily fished, rust proof, easily bent, strong, easy to handle.

Sherarduct is only one of the many outstanding products made by National Electric—a reliable source of supply for your future electrical needs.

m.i.t.'s psychiatric service (*Continued from page 11*)

be free to work unhampered by disturbing inhibitions and repressions. Psychotherapy also includes the treatment of the anxiety and distress that occurs in the course of all types of bodily illness.

There are two general types of psychiatric treatment, one relatively superficial, the other somewhat complicated, involving rather deep probing into personality structure. The first includes help in the management of the individual by changing his environment, by improving his physical condition if necessary, helping him understand his own emotional reactions, and by reassurance so that his anxiety is relieved. In the other type methods and techniques are used which aim at finding some of the motivations for behavior as they relate to unconscious forces which may come into conflict. In a psychiatric interview there is no division between becoming familiar with the patient's problems and helping him solve them. The whole interpersonal relationship which constitutes the interview between the patient and the psychiatrist is a treatment process.

During the course of the interview it is desirable that the patient be as frank as possible with the psychiatrist. As a part of the defense that the patient builds up against anxiety he may have suppressed or repressed painful material so that being frank with the psychiatrist may be painful or virtually impossible at first. He may be unconscious of the sources of his anxiety. It is desirable for the psychiatrist to know the symptoms that bother the patient. He should understand clearly the relationships in the patient's home, the general character of those closely associated with them. Unusual behavior in childhood, school attainments, religious background, development of sexual attitudes, and traumatic episodes of a dramatic nature are all important in treatment. The psychiatrists must discern the capacity of the student for entering into satisfying human relationships. As a general rule it is desirable that the patient relate his problems from his point of view rather than sitting back and insisting that the psychiatrist question him. The latter method can easily degenerate into a game of evasion wherein the patient unwittingly tries to give the psychiatrist as little significant information as possible.

In general any student should feel justified in seeking a psychiatric consultation when he notices any of the following types of behavior in himself: 1. Preoccupation with some personal concern leading to social isolation or change in living habits. 2. Impairment of memory and concentration. 3. Tendency to be very critical of one's self with annoying thoughts of futility of living. 4. Sudden lowering of scholastic standards. 5. Excessive cutting especially when one has previously been reliable and punctual in class attendance. 6. Preoccupation with sexual matters to the extent of interfering with academic work. 7. A feeling of general unhappiness.

There is no single group of persons in the Institute that require help more than other groups. All four classes of undergraduates, the graduate students, the employees, and faculty request and need consultations in about the proportion of their number on the campus. There is no tendency for emotional problems to be concentrated in those who are not particularly well endowed intellectually or in the brilliant students. Emotional situations are common to all human beings, and most of them are solved by each individual, but occasionally the need for objective help becomes quite urgent, and this is just as likely to happen in the brilliant student as in the one who is just barely managing to stay in the Institute. Therefore the current concept that the need for psychiatric help is equivalent to admitting weakness has no validity, and anyone should feel free to accept help without loss of face. Indeed in the Institute this tendency to consider psychiatric help as being of exactly the same nature as asking medical help has been most gratifying.

There is a most serious problem connected with the acceptance of psychiatric help freely and that is the shortage of trained psychiatrists. A potential patient may agree that psychiatric help is desirable and then be unable to secure a psychiatrist or pay the regular fee if he does get an appointment. This shortage which will probably be corrected only gradually over a period of years makes it quite necessary that a liberal portion of the college psychiatrist's time should be devoted to the study and correction of factors in the educational environment of the institution which tend to produce emotional disturbances.

Incidentally, many students fear that if they consult a psychiatrist the

(*Continued on page 32*)

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giant brains

(*Continued from page 15*)

matically some rather complicated mathematical functions, like logarithm or sine. It has done difficult and important problems. It has computed and tabulated *Bessel functions, definite integrals*, etc. It can solve *differential equations* and many other problems in mathematics, physics, and engineering.

In 1946, Bell Telephone Laboratories finished two *general-purpose relay calculators* — mechanical brains. They were twins. One was shipped in July 1946 to the National Advisory Committee for Aeronautics at Langley Field, Virginia. The other, after some months of trial operation, was shipped in February 1947 to the Ballistic Research Laboratories at the U. S. Army's Proving Ground, Aberdeen, Md. There are many important differences between Bell's relay calculator and the Mark I. First of all, it is constructed almost *entirely* of *two-position* relays. Second, it does not function by means of the decimal system but uses a different symbology called the biquinary system — the bi-, because it is partly twofold like the hands, and the -quinary, because it is partly fivefold like the fingers. This is the system used in the abacus. Each decimal digit is recorded on seven relays. These relays are called the 00 and 5 relays, and the 0, 1, 2, 3, and 4 relays. It can be seen that by actuating only two relays, one from the first group and one from the second, any decimal digit can be represented. This calculator is remarkably reliable and versatile even though it is no faster than the Mark I. It can do a wide variety of

(*Continued on page 31*)

art in bronze

(*Continued from page 12*)

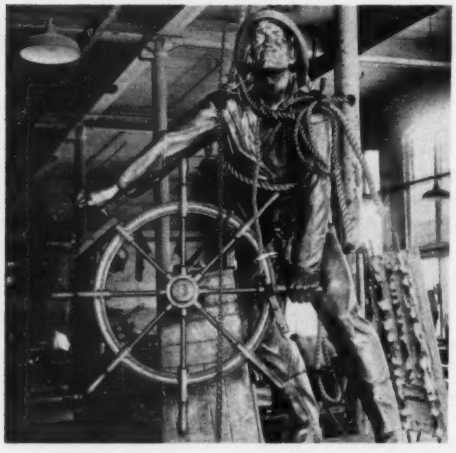
Provided with plaster replicas of the eventual statue the foundryman proceeds very much as he would with an ordinary casting. A sand mold is made of each section in the usual manner and a foundry sand casting is made with each one. This is removed and shaved down the same amount as the finished casting is expected to be thick. This core is placed back into the mold, properly positioned and we are ready to pour.

The distance that molten metal will flow depends on the fluidity and volume. A large thick stream will remain in the liquid state and flow farther than a small thin stream exposed to the temperature-robbing effect of the mold walls. The walls of a statue or other ornamental bronze are relatively thin, and the metal from a small gate, irrespective of its fluidity, will not flow far from its source. The foundryman's solution to this problem is the introduction of many gates, each designed to fill one small definite part of the mold. The metal must also be completely fluid in each of these parts so that when it meets the metal from another gate it will unite completely.

Since each statue cast is so individual, no definite rule can be laid down concerning these gates, but in general the following method is used. A large reservoir is constructed over the mold and a large sprue from the bottom of this conducts the metal into a system of smaller sprues to all of the smaller gates, much like the roots of a tree.

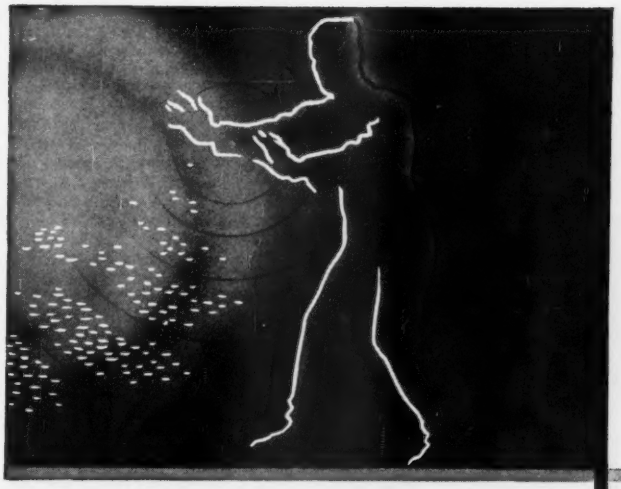
All gates are directed toward one or two upright sprues. A large basin capable of holding the required amount of metal is prepared, dried, and placed on the top of the mold so that the openings coincide with those of the sprues. A clay plug built around an iron rod is placed in each opening. The rod extends above the top of the basin and terminates in a ring by which

(*Continued on page 38*)



The Foundry

Another famous figure created in Gorham's shops. Called "They That Go Down to the Sea in Ships," the fisherman commemorates those lost at sea out of Gloucester, Massachusetts.



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atmospheric dust

(*Continued from page 13*)

was named after its ship, "The Challenger," which made several cruises in the years 1872 to 1876 to explore the depths of the ocean. An extensive collection of samples of sediments from the bottom of the ocean was made. In the deep sea oozes, dredged from depths of 15,000 feet or more, the British scientists, Murray and Renard, found some mysterious microscopic globules. These were black in color, had magnetic properties and were composed of iron and iron alloys. Murray and Renard suspected that these particles were of extraterrestrial origin. They called them "cosmic spherules." There was, of course, no proof that the particles were really of meteoric origin and this discovery, announced in 1891, was more or less forgotten.

In fact, many scientists believed that cosmic dust, hitting the earth's atmosphere at terrific speeds of 15 or more miles per second, would gassify and never reach the surface. This belief was strengthened by negative results of a systematic search for cosmic particles at the time of an extraordinary astronomic event. In 1910 astronomers predicted that the earth would pass through the tail of Halley's Comet. The more excitable contemporaries of that event thought this would spell the end of our planet. In spite of some dire forecasts the earth is still here but some astronomers and meteorologists at the time thought this collision would be a good opportunity to find some cosmic dust in the atmosphere. They didn't find any. In retrospect we might say today that their procedures and equipment were not adequate for the task. So the question of cosmic dust remained in the realm of speculation.

In 1946 nature offered another opportunity. The great cloud of cosmic debris named for the Italian astronomer, Giacobini, was due for a collision with the earth. The contact was predicted for October 8 to 10. Another attempt was made to collect samples of the dust that might penetrate into the atmosphere on this occasion. This collection was made in northern Virginia and covered several weeks, before and after the meteoric shower. The locations of collection were far removed from sources which might contain magnetic pollution products from smelters or other industrial sources. Before the Giacobinid shower not a single magnetic particle was found in the collections. On the eleventh of October 1946, a fairly large, opaque, magnetic particle was discovered. In the succeeding two weeks nine more but smaller particles were found. They were all strongly magnetic and completely different from all the other dust that collected on the exposed slides. The smaller of these particles were round with diameters of about 1/1,000 of an inch. Other particles were wedge-shaped, somewhat streamlined objects. Their rate of fall was calculated from the dimensions. These calculations placed them at heights of 50 to 90 miles above the surface of the earth on the day of maximum intensity of the shower. On that day radar observations in Virginia showed contacts with the cosmic debris at heights varying from 45 to 180 miles above the surface. The absence of similar particles before or after the meteoric shower and the agreement between observed and calculated height lent support to the suspicion that the magnetic particles collected were really cosmic dust.

Yet there remained the doubt about their survival in the atmosphere. Dr. Fred Whipple of the Harvard Astronomical Observatory investigated this question. Last year he published a brilliant theoretical study on the subject. He based his calculations in part on the recent temperature and density observations in the upper atmosphere obtained from V-2 rocket ascents. He deduced that particles of the sizes found in Virginia after the Giacobinid shower could survive the trip through the atmosphere without vaporizing because they radiated as much heat as they accumulated by friction. Dr. Whipple called these small particles micrometeorites. He believes that these cosmic dust pellets may be messengers that will permit us to learn more about the origin of comets. While the big meteoric masses are assumed to originate in our own solar system, the micrometeorites may come from interstellar space and thus be the only material witnesses which reach the earth from the depths of the universe. A systematic study of this cosmic dust may open up an entirely new field of research and permit us new vistas into the great mysteries of the universe.

"giant brains"

(*Continued from page 28*)

calculations in a great many ways. Yet the machine never takes a new step without a check that the old step was correctly performed. There is, therefore, a chance of less than one in a *hundred billion* that a wrong result will come out.

So far we have seen how counting devices developed into mechanical calculators and then into electro-mechanical calculators. The next step up on the evolutionary scale is obvious — *electronic calculators*. In the Department of Terrestrial Magnetism in the Carnegie Institute of Washington, a great deal of information about the earth is studied. Many kinds of physical observations are gathered and analyzed: electricity in the atmosphere, magnetism in the earth, and the weather, for example. In 1941, a physicist, Dr. John W. Mauchly, was thinking about the great mass of numerical information they had to handle. He became convinced that much swifter ways of handling these numbers were needed. He was certain electronic devices could be used for computing at very high speeds, yet he found no one busy applying electronics in this field. With hopes of finding some way of developing electronic computing he joined the staff of the Moore School of Electrical Engineering in the autumn of 1941. The final result was the ENIAC. This name comes from the initial letters of the full name, Electronic Numerical Integrator and Calculator. By the beginning of 1946, ENIAC was complete and promptly set several world's records. He was the first *Giant Brain* to use electronic tubes for calculating. He was the first one to reach the speed of *5000 additions a second*. He was the first piece of electronic apparatus containing as many as 18,000 electronic tubes, all functioning together successfully. As soon as ENIAC started thinking, he promptly made relay calculators obsolete from the scientific point of view, for they have a top speed of perhaps ten additions a second.

Up to now we have only discussed machines that handle *numbers*. There are, however, machines which instead of numbers handle *information*. These are the International Business Machine Corporation's (IBM) *punch-card machines*. To use these machines, holes representing information are punched into cards. These cards are then fed into the machines where they are "read" and transformed into a pattern of electrical impulses. The resulting electrical patterns are then correlated in some predetermined manner and the desired results obtained. For example, in a life insurance company, much routine handling of information about insurance policies is necessary:

Writing information on newly issued policies.

Setting up policy-history cards.

Calculating and tabulating premium rates, dividend rates, reserve factors, etc.

Computing and tabulating expected and actual death rates; and much more.

All these operations can be done almost automatically by punch-card machines in conjunction with automatic electric typewriters. The operation of these IBM machines are too complex and their many applications too numerous to go into at any great length, but it will be realized that in any field where large amounts of statistical or clerical data are handled, they are invaluable.

There is yet another type of machine that handles not numbers or statistics, but *logic*. This is the *Kalin-Burkhart Logical-Truth Calculator* which was finished in June, 1947. Its main work is with what is logically true and what is logically false. Again this machine is too complicated for any detailed explanation here. The function is this, however: first, statements are given the machine which are considered to be true. Then questions are asked and answers are obtained that are valid according to the original statements.

The *Giant Brains* mentioned so far are representative of types. Actually there are many of these calculators now in existence, both in industry and in research laboratories. General Electric has developed an electronic digital calculator that works on the *binary* system of symbology. This is a counting system based on two rather than ten as is our decimal system. Although officially unnamed, this *Giant Brain* is presently referred to as OMIBAC, an abbreviation for "Ordinal Memory Inspecting Binary Automatic Calculator." The Bureau of Standards has unveiled what they hail as the fastest calculator in operation, the SEAC, which is going to work for SCOOP. Its full name is National Bureau of Standards Eastern Automatic Computer. SCOOP is the Air Force's Scientific Computation of Optimum Programs project. The *Whirlwind Calculator* at the Massachusetts Institute of Technology, although still incomplete, is already proving itself worthy of the title *Giant Brain*. An innovation employed in this calculator is the *electrostatic storage tube*. This device, operating very similarly to an image orthicon, records numbers as small spots of electricity on its face; it is a "speed-of-light" memory. One of the Whirlwind's many achievements so far has been the analyzing of tremendous amounts of rocket data gathered at White Sands, New Mexico.

This, then, is a brief outline of the evolutionary past of *Giant Brains*. What about the present? Their use in the airplane industry, a very recent application, affords a good example. Detailed design data can be given to these machines and answers obtained that would otherwise require a tremendous number of man hours. More important, there are some questions that couldn't be answered in any other way. Because of these calculators, million-dollar wind tunnels are losing their importance, and test pilots can thank them for a safe plane ride, right from the first zoom into the sky. Northrop Aircraft, Inc., for example, wanted to find out how much effect a certain wind pressure would have on a rubber diaphragm. BINAC, its room-sized computer, provided the answer in seven minutes — a man would have required a year. North American Aviation, Inc., is using these *Giant Brains* on every plane they build. Problems in modifying existing planes for special types of warfare — as in Korea — will also be solved by these electronic mathematicians. Mathematically testing a not-yet-built plane will give at least as accurate an estimate as to the plane's performance as will testing many, many models of the plane in an expensive wind tunnel. Such mathematical tests were impossible before these big computers won their wings. A battery of skilled mathematicians with pencils or small computing machines just doesn't live long enough to figure out some of the more complex problems. These mechanical mathematicians are making it safe for test pilots by removing much of the guess and hope from aircraft building.

Finally, what can we expect in the future from these *Giant Brains?* Just about anything is the best answer to that question. Any and every field where *thought* is involved is liable to be invaded by thinking machines. A common misconception is that machines can't *think*, only compute. This is only true if "think-

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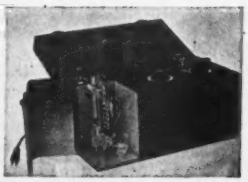
CAMBRIDGE electron-ray RESEARCH pH METER



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m.i.t.'s psychiatric service

(*Continued from page 26*)

result of the interview will be placed on their official Institute record, which will then interfere, not only with the attainment of various student goals, but with obtaining a job after graduation. This is, of course, not true. It is true that records are kept, as of necessity they must be if proper care is to be given. They are not even made a part of the general medical record, and no one but a physician may have access to them and then only with the written permission of the patient or of his legal guardian if he is not able to sign for himself. In this way the essential privacy of the physician-patient relationship is maintained, and any student may feel free to speak his mind freely no matter who may be the object of his hostility or concern.

The psychiatric service is not a long arm of the administration, either. There is close cooperation between the psychiatric service and the Dean's Office as well as other departments of the Institute regarding all matters having to do with student morale and welfare, sources of discontent and ways and means of improving the educational environment, but this cooperation does not extend to reporting to the Dean any behavior which if known to him might require disciplinary action. Obviously many situations may arise when interpretation of this criterion is difficult. However, it can practically always be worked out satisfactorily with the consent and cooperation of the patient.

Psychoanalysis is not practiced in the psychiatric service. The reason for this is that this procedure requires one hour a day for one or more years and is obviously too expensive for general use. Several psychiatrists on the staff are analytically trained, and all of them make use of many of the facts and theories of psychoanalysis in their psychiatric treatment. The Institute does not attempt to render definitive psychiatric treatment for a student who must be seen over a long period of time.

If psychiatry is to accomplish its chief mission, namely to help people live full and active lives free from disabling anxiety and fear, it must pay attention to the factors in our society which give rise to these unpleasant emotions. Thus, in an educational institution such as this one, the attitudes of students and faculty toward one another, the over-emphasis on grades and material success, the prevalence of cheating, signs of social and racial intolerance, and the necessity of exercising value judgments are all fields of great interest to the psychiatric service. Likewise on the national scene similar attitudes are of interest and in addition the evils of religious intolerance, excessive nationalism, selfishness or pressure groups and prejudices are all of major importance in determining the presence or absence of emotional disturbance in the individual.

Education is not something acquired by four to seven years of study at this or any other institution. It is a way of life, a process of growth, a search for truth in its various aspects. The educational process at M. I. T. is vastly more than learning the scientific methods and the content of various disciplines and their application to the material development of our society. It must also consist of being aware of the value judgments one makes and acquiring the necessary integrity of character to act on them. It also includes the acquisition of culture in the sense expressed by Whitehead: "Culture is activity of thought and receptiveness to beauty and humane feeling."

But, you may say, that is not the proper field of psychiatry since psychiatry is a medical specialty and those who practice it should restrict themselves to the treatment of people who are emotionally or mentally ill. True, there is more of this specialized work to be done than there are psychiatrists to do it, but this is precisely the reason why psychiatry is beginning, along with many other disciplines, to pay attention to the prevention and amelioration of those factors in our society which hinder the individual in his attempt to live in a full and satisfying manner.

The psychiatric service at M. I. T. is therefore as interested in the study and correction of those factors in the educational environment which prevent or slow down the attainment of emotional maturity as it is in the treatment of sick students although most of its time will of necessity be spent in performing this latter function.

"giant brains"

(*Continued from page 31*)

ing" is construed as mental processes influenced by human instincts and personal prejudices. Actually these *Giant Brains* function mechanically very similarly to the human mind; the main difference at the present is that they lack the versatility and over-all capacity of the human brain. With this in mind, keep an eye on the continuing evolution of "machines that think." Watch closely as these mental machines change the entire world and give to people things that were never before possible as once did the mechanical machines of the Industrial Revolution.

"Where opportunity knocks every day"

This huge new building pictured above is one of the world's most modern petroleum research laboratories—those of the Standard Oil Development Company at Linden, N. J. It is the research center where Esso Products are constantly developed and improved by engineers and technicians whose aim is better products for better living all over the world.

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The 27,000 workers at Esso have been with the company an average of 13 years... 8,700 of them for 20 years or more. Esso is proud to have this large number of "career employees," enjoying fair pay, good working conditions, and a chance to learn more about the oil business and to advance in the company.

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briefing the news

Old Ideas Challenged . . .

Textbooks have said for years that the melting point and the solidification point of a metal are identical temperatures. It isn't so, according to General Electric Research Laboratory scientists.

The scientists have been studying the behavior of metal droplets by means of special microscope equipment. They have found that the solidifying points of metals are far lower than previously believed — lower than the temperatures at which they melt.

It is impurities which cause metals to solidify at their textbook solidification points, according to G. E. scientists. The barest trace of impurities is enough to make molten metals "freeze" at temperatures above the solidification points for pure metals, they said.

The new microscope equipment makes it possible to study metals absolutely free of impurities, which are not found in nature, and which are rarely produced by man. This purity is achieved by dividing nearly-pure metal samples into tiny droplets. Certain of the droplets will, by chance, be pure.

The new microscope attachment is a temperature-controlled metal chamber with a quartz window in it. By watching the droplets in the chamber through the quartz window with a microscope, the scientists can count the number of droplets solidifying as the chamber temperature is lowered.

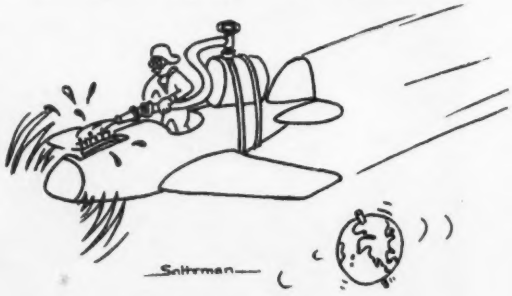
Certain of the droplets, free of impurities, have been seen to remain molten well below the supposed solidification point for whatever metal is being studied.

This has proved to be true for every metal tested to date. The growing list now includes selenium, bismuth, lead, antimony, cobalt, iron, and palladium. In each case, the temperature at which the pure droplets solidified was roughly 20 per cent lower than the melting point in terms of degrees above absolute zero.

Graphite Isn't Slippery, But . . .

Electric contacts or "brushes," made of graphite and used to feed current to moving parts in motors or generators on high-altitude aircraft, may have their useful life increased many thousands of times as the result of new lubrication methods devised by Robert H. Savage, in the General Electric Research Laboratory here.

His discovery about water, in the form of vapor, for the lubrication of graphite has changed accepted



ideas that this solid and "slippery" material was a good lubricant in itself. Graphite consists of layers of atoms which can slide easily over each other, and it was formerly supposed that this property was inherent in the graphite alone.

He has shown, however, that an invisibly thin film of moisture on graphite is required for its lubrication. Testing the wear against a revolving copper disk in a vacuum chamber, he found that dry graphite brushes were worn as fast as an inch within one hour. When a small amount of water vapor was admitted to the chamber, the wear rate was reduced to less than a thousandth as much.

For electric motors and generators working on the ground, the wear of brushes is no great problem, since there is generally enough water vapor in the air to provide the lubricating film of moisture. But modern aircraft, such as jet aircraft, fly at great altitudes in rarefied air at such a low temperature that water vapor is almost completely absent. Many motors and generators are required in such planes. Various methods of treating brushes chemically to prolong their lives have been tried, but still further improvement is needed.

Mr. Savage has devised a means of shielding the parts of electric equipment where the brushes are used, and supplying water vapor to the space around them. In tests with this equipment he has found that brushes which wear out in an hour without water vapor, will last from 2000 to 8000 hours. Certain organic vapors are more effective than water by a factor as large as 1000, so that extremely small concentrations (in the order of parts per million) provide lubrication.

Further developments are now being carried on, to apply the findings to actual aircraft where the wide range of operating conditions impose some problems that have yet to be solved. The practical merits of equipment with shielded parts are undergoing evaluation in comparison with equipment using chemically treated brushes.

(*Continued on page 38*)

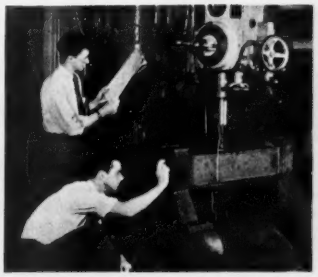
THE DU PONT DIGEST

Engineers At Work

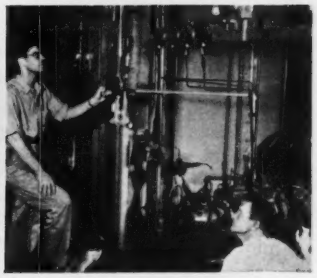
AT DU PONT THEY FIGURE IMPORTANTLY IN MANY FIELDS

R. E. Sugg, *B.S. in M.E., George Washington University, 1948, doing mechanical research to improve machine design. His optical-slit microscope measures surface scratches as fine as 20 millionths of an inch.*

Studying product development *in a rotary dryer are: H. J. Kamack, B.S. in Ch.E., Georgia Institute of Technology, 1941; and F. A. Gluckert, B.S. in Ch.E., Penn State, 1940.*



Checking component *for machine used to finish rolls to high degree of precision: Donald F. Miller, B.S. in M.E., Lehigh, 1950; and Albert W.G. Ervine, M.S. in M.E., Michigan, 1950.*



R. L. Stearns, *B.S. in Ch.E., Yale, 1949; and H. Peterson, B.S. in Ch.E., Northeastern University, 1942, checking a multi-stage carbon-monoxide compressor used for making methanol.*

BECAUSE Du Pont is a chemical company, you might expect most of its technical men to be chemists.

Actually, there are more engineers than chemists at Du Pont. In each of the ten manufacturing departments there is important work for men trained in chemical, mechanical, electrical, metallurgical and other branches of engineering.

These departments operate much as independent units with their own research, development, production and sales staffs. In their respective fields, they do fundamental and applied research on both processes and products. Sometimes engineers participate in the early stages of a project. More often, however, they enter the picture when the project has moved to the point where commercial production is considered. They see it through the pilot plant and semi-works stages and assemble data necessary for the full-scale plant.

Even after manufacturing has begun, development work is continued to standardize and improve the process. Normally, engineers whose main interest is production and plant operation take over when the works stage is reached.

Engineers on the technical sales staffs help maintain contact between Du Pont and its customers. They present data on new products and guide customers in process development and similar problems. They also use their technical knowledge in making surveys of possible markets for the Company's products.

In addition to the manufacturing groups, the Du Pont Engineering Department—a central staff organization—requires engineers with many types of training. This Department carries on its own program of fundamental and applied research. It also makes site investigations, lays out and designs new plants and laboratories for the manufacturing departments. It serves them in research on process development, on materials of construction and on methods of measurement and control.

Yes, engineers figure importantly at Du Pont. Through their teamwork with chemists, physicists and other trained personnel, the Du Pont Company produces its "Better Things for Better Living...through Chemistry."

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...THROUGH CHEMISTRY

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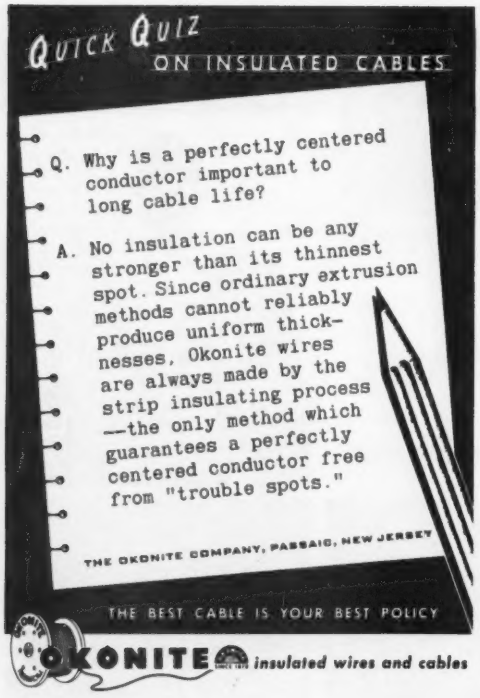

QUICK QUIZ
ON INSULATED CABLES
Q. Why is a perfectly centered conductor important to long cable life?
A. No insulation can be any stronger than its thinnest spot. Since ordinary extrusion methods cannot reliably produce uniform thicknesses, Okonite wires are always made by the strip insulating process —the only method which guarantees a perfectly centered conductor free from "trouble spots."
THE OKONITE COMPANY, PASSAIC, NEW JERSEY
THE BEST CABLE IS YOUR BEST POLICY
OKONITE insulated wires and cables

foreign automobiles

(*Continued from page 25*)

less than 91 cubic inches, the Jupiter will do between 95 and 100 mph. With the engine situated well forward, the passenger load is carried equally between the axles, with consequent increased riding comfort and a reduction in pitching over rough surfaces. The clean lines of the Jupiter ensure high speed capability which will not be too expensive.

The famous M. G. two-seater sports roadster has been the means for starting sports car clubs not only in England but also in America. In fact not only has one M. G. Car Club been started in America, but so keen has been the response that it has been necessary to start branches in widely scattered parts of the country. M. G. has always specialized in producing sports cars, or cars for the enthusiast. Although the M. G. organization has not participated in races since the war, it still retains a very high reputation from its successful performances before the war. Colonel Gordan with his M. G. car holds over 50 per cent of the short distance international records, the fastest being over 200 mph. The sports roadster has a 76 cubic inch, four cylinder, overhead valve engine and a top speed of 72.9 mph. From a start, it will accelerate over a distance of a quarter of a mile in 21.8 seconds. It delivers 28.5 miles per gallon at 60 mph. The sports roadster has been modified to suit the wishes of American owners, and it should provide many hours of enjoyment to motor enthusiasts.

The French are building what many people believe will be the cheap car of the future, the Renault. It has either a front wheel drive or a rear-end engine, thereby eliminating a long drive shaft, and lowering the center of gravity. The car sticks fast to the road and cruises at 50 mph with a fuel consumption of 40 miles per gallon. The Renault sells for $1,035 in New York City, and one can drive from there to Los Angeles on twenty dollars worth of gasoline and oil.

The Panhard, a French car, has a four cylinder, horizontally opposed air cooled engine. It closely resembles those used on light planes in this country. The body and engine are made of aluminum. It weighs 1,034 pounds, cruises at 50 mph while obtaining 46 miles per gallon of gasoline, and sells for $1,390 in New York City.

The Citroën "II" has an engine with removable cylinder linings. This is characteristic of many French cars. Removable linings offer a tremendous advantage, because the worn sleeves can be replaced, making boring unnecessary. The Citroën "II" while cruising at 50 mph delivers 19 miles to the gallon, and it sells for $1,475 in New York City.

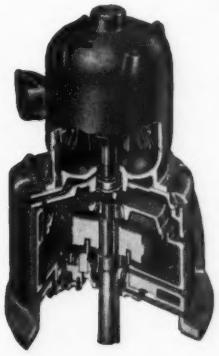
Not all French cars are small, cheap, and light. The Delahaye costs about $10,000. It is custom-built throughout, and it has enough instruments to fly a Constellation. The Delahaye loafs at 75 mph, and since France has no speed limits, many drivers nip along between 90 and 100. The low slung convertible model makes 11 miles to the gallon, but many Frenchmen are still driving their durable Delahayes made in 1930.

The confection of fine foreign cars bears many resemblances to the French *haute couture* — small volume, high style, choice materials, highly refined, and much hand workmanship. These luxury cars are not produced so much in factories as in mechanical ateliers. There are no huge investments in mass production such as characterizes Detroit.

Such conditions are responsible for the joys and sorrows of owning deluxe European cars. Well-to-do enthusiasts often accept the sorrows for the benefit of the joys, but of the very special sorrows there can be no doubt. In the first place, the high level performance is often achieved by considerable mechanical complexity, as compared with the simplification developed by the American industry in order to facilitate mass production. In other words, a foreign car may require such an amount of tuning and repairs that it would seem absurd and expensive to the contented American car owner. Again, foreign designers, in their reckless love for high performance automobiles, sometimes make their affections a nuisance. During most of his designing life, for example, Eltore Bugatti refused to adopt the convenience of detachable cylinder heads for the proud reason that a solid engine block can be a stronger construction.

In the United States there are special hazards involved in owning a fine foreign car. Outside of metropolitan centers, servicing is difficult if not impossible, and it is likely to be exorbitant. American mechanics can scarcely be expected to trim their fees for drivers who can afford an Alfa Romeo or Delahaye. In short, the possessor of a work of art in automotive form must be prepared to pay for it like the owner of a Picasso.

Another page for **YOUR BEARING NOTEBOOK**

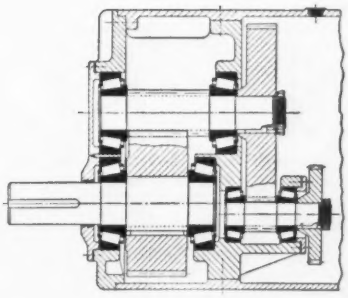


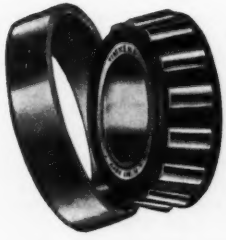
How to help a gearmotor take care of its teeth

To minimize wear on the teeth and to insure smooth, quiet operation, reduction gears in motors like this must be held in perfect mesh, no matter what the load. That's one reason why engineers mount the gear shafts on Timken® tapered roller bearings. Timken bearings hold the shafts in accurate alignment. Gears are kept perfectly positioned, with each tooth meshing smoothly and carrying its full share of the load.

Gears mesh smoothly, wear longer, with shafts on TIMKEN® bearings

Here is a typical gear-case countershaft showing a common method of mounting Timken bearings. Due to the line contact between the rolls and races, Timken bearings give the shaft maximum support. There's less chance of deflection under load. The tapered bearing design takes both radial and thrust loads in any combination. End-movement of the shaft is kept to a minimum. Gears wear longer—work better.





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Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

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from the editor's notebook

(*Continued from page 19*)

I hope you have those intellectual experiences where some new concept or esthetic experience or some powerful emotion throws you into a state of excitement or disturbs you so deeply that you are compelled to talk about it or share the enthusiasm with others.

I hope that you will let yourself go when you are kindled by some new enthusiasm. We are too much beset in our times by fears and repressions. We need as a people and as individuals more capacity for enthusiasm, more receptivity to inspiration, more vehement advocacy of ideals.

I hope, further, that you will have ample opportunities to participate in the pageantry and group activities of college life. The athletic games, the social activities, the sings are an essential part of college and can provide at times an uncomparable lift and a sense of belonging.

In summary, I suppose that I have been trying to say that I hope you will realize yourself fully while in college and that in doing so you will develop a sense of values, a recognition of what is beautiful, true, and good, in people, in books, in materials, in politics, in life. "No lesson is so important to learn," said Aristotle, "and no habit is so important to acquire, as a right judgment and a delight in fine characters and noble actions."

With these aptitudes and objectives your career here can be one of happiness and achievement, and you will become a part of the great family of students, teachers, and staff who love and cherish this institution.

As for the Writers...

Dr. Farnsworth is the Medical Director and the Acting Dean of Students; his wide experience in psychiatry qualifies him to tell us about its application at Tech. **Bob Redick** is hot on computers, and further he talks about them capably. **Bob** is an old hand. He plans to further his study of calculators in Course VI. **John Peterson** and **Bert Krauss** are freshmen and hence new to the staff. There are signs that these offerings are but first in a series. **Tony Ranti** is our Advertising Manager and quite obviously he took some time out to write people, to read and to find out about foreign cars. Quite an accomplishment for the summertime. **Joel Ekstrom** is an outdoor man — geology, hiking and the like occupy his less clairvoyant moments. **Dr. Landsberg** is on the Research and Development Board; his words crossed our desk in a news release.

art in bronze

(*Continued from page 28*)

it is lifted after the basin is filled with molten metal. A small riser on the highest part of the mold is used to indicate when the mold is full. (*Note:* One slip in this stage and the work must be begun again for the mold cannot be easily reclaimed.) Surplus metal is then drained away to the melting furnace to be used again. The most common mixture of the bronze for statuary purposes is copper eighty-five per cent, and five per cent of each tin, lead, and zinc.

Once hardened the individual sections are removed from their molds and assembled to the finished product.

briefing the news

(*Continued from page 34*)

Round-the-World Radio Signals..

Very low frequency radio signals traveling completely around the world have now been detected by Jack N. Brown of the National Bureau of Standards. The signals, transmitted from the Naval Radio Station NSS at Annapolis, Maryland, on a frequency of 18 kilocycles with a power of 350 kilowatts, were received at the National Bureau of Standards radio propagation field station at Sterling, Virginia, about 50 miles away.

The round-the-world signals were received, with the aid of a large loop antenna 150 feet high, on a tuned-radio-frequency receiver. A dual-beam oscilloscope was connected ahead of the detector stage in the receiver so that the actual unrectified r-f envelope was displayed on the 5-inch screen along with an 18-kilocycle reference voltage.

During the winter months when these tests were conducted, the delayed signal was visible throughout the entire day. Observations of field intensity over several 24-hour periods disclosed the striking sunset maximum. A sharp peak in signal strength at 4:30 p.m. corresponded to optical sunset at the place of transmission and reception. It is an observed fact that low-frequency signals are severely attenuated when their path crosses a sunset zone. Any round-the-world signal must cross a sunset zone except during that portion of the day when the sunset zone is at the transmitter-receiver location. This explains the relatively greater strength of the signals at sunset in the transmitter-receiver location.

Delay times were measured on two different occasions under widely differing ionosphere conditions. Measurements were made first during a severe ionosphere storm, and a second set of measurements were made on a normal day. The average delay time during the storm was 0.1365 $\pm$0.0005 seconds, but on a normal day the average was 0.1373 $\pm$0.0005 seconds. The shorter delay time during a storm may be explained by the slightly lower effective height of the reflecting layer of the ionosphere under the influence of corpuscular bombardment from the sun.

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Chemical Engineering Practice

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- Options: Human Relations
  Industrial Economics

Electrical Engineering
- Options: Electric Power
  Electrical Communications
  Electronic Applications

Electrical Engineering
Co-operative Course

General Engineering

Marine Transportation

Mechanical Engineering
- Options: Power
  Materials, Design and manufacturing
  Automotive

Mechanical Engineering
Co-operative Course

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- Options: Metallurgy
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Food Technology — Five Year Course

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The duration of each of the above undergraduate Courses is four academic years and leads to the Bachelor's degree, with the following exceptions: (1) Architecture and Marine Transportation, which are five-year courses leading to the Bachelor's degree; (2) Food Technology (Five Year Course), Physical Biology, and the Cooperative Courses in Electrical Engineering and in Mechanical Engineering, which extend over a period of five years and lead to the Bachelor's degree and the Master's degree.

Graduate study may be pursued in Textile Technology, Ceramics, Sanitary Engineering, and in most of the above professional Courses. The Master's and Doctor's degrees are offered in most of these fields.

For information about admission, communicate with the Director of Admissions. The Catalogue for the academic year will be sent free on request.

How much magic can a square inch hold ?

Just a frame of movie film—but think what it can hold. Accurate detail, motion, sound, even lifelike color and much more—miracles that work magic in entertainment, and in business and industry as well.

Here, in a tiny area far too small to examine easily, photography has captured a moment of life faithful in its finest detail—captured it complete with sound—conversation and music. And all this that's been recorded can be endlessly duplicated so that all the world can thrill to its beauty and drama at the same time and in the language of any land.

Such are the wonders of photography. They are wonders that serve entertainment—can serve science, business, and industry in countless ways as well.

For example, motion pictures can present your product or services graphically and colorfully. They can explain production methods—dramatize safety measures—train salesmen. They can spark interest and understanding in the classroom.

With pictorial animation they can make difficult processes clear. They can make time go fast, go slow, or even backward, to facilitate a study or improve a demonstration. All of this because of the inherent magic in photography.

You can use this magic in your occupation. When you meet problems in production, management, or sales, it will pay you to find out how they can be handled better, faster, and more accurately through photography.

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